

Brookline Bicycle Network Draft Master Plan

Prepared by the Brookline Bicycle Advisory Committee
February 2007

EXECUTIVE SUMMARY

To improve bicycle safety and promote bicycling for transportation and recreation, the Brookline Bicycle Advisory Committee proposes that the Town of Brookline create a network of bicycle routes connecting neighborhoods with key destinations within and outside the Town.

The proposed network, shown in the Route Plan (Figure 1), has two classes of routes: Safe Routes to School and Adult Cyclist Routes. Safe Routes to School, consisting of the non-red routes numbered 1 through 8 on the Route Plan, will facilitate children's transportation to school and playgrounds, as well as family and adult recreational cycling. They connect Brookline's neighborhoods with the High School, parks and open spaces within the Town, and open space destinations near Town borders such as the Charles River bicycle paths and Jamaica Pond. Safe Routes to School will have a level of separation from traffic that makes them safe and attractive to children cyclists, as well as to adult bicyclists uncomfortable riding alongside heavy motor traffic.

Adult Cyclist Routes will complement the Safe Routes network by providing additional connections within the Town and to neighboring communities. Adult Cyclist Routes, shown in red on the Route Plan, use busier streets less suitable for children's cycling.

Many of the recommended routes involve contraflow travel on one-way streets, an effective way of providing bicycle routes on streets with limited traffic.

Destination (also termed wayfinding) signs will guide cyclists along the network. They also advertise the bicycle network to cyclists and motorists alike.

Routes will be improved to ensure safe accommodation of cyclists. A variety of accommodation options are described, including off-road paths, sidewalk-level paths, bike lanes, shared lane schemes, and contraflow lanes permitting two-way bicycle travel on otherwise one-way streets. Criteria are provided for determining appropriate designs for streets in the Safe Routes to School network, whose target users are children aged 11 to 15. This plan does not recommend safety improvements for particular streets; it calls for route improvement plans to be developed, consistent with the Master Plan's design guidelines, as opportunities for improving individual routes arise.

An Action Plan offers a timeline for completing a substantial part of the network within three years.

1. INTRODUCTION

Motivation

The Town of Brookline desires to improve conditions for bicycling and to promote bicycling by children and adults, for both transportation and recreation. Bicycling is an attractive and efficient mode of transportation for trips whose distance is in the range of 0.75 to 5 miles. A large fraction of Brookline residents make trips in this range, including local errands and work trips to such destinations as Cambridge and Boston. Our youth, in particular, make many trips in this range, going to school, to playing fields, running errands, and visiting friends. For those living too far from school to walk there, bicycling offers a means of traveling to school independent of bus schedules, without driving or being driven in a car, improving opportunities for participation in extra-curricular activities. In comparison with driving, bicycling reduces traffic congestion, parking need, energy consumption, and air pollution. Bicycling to work or school is also a way to get routine cardio-vascular exercise with little or no incremental time commitment. Many Brookline residents want this kind of opportunity for themselves and for their children.

Bicycling is also a popular form of individual and family recreation. Brookline residents want opportunities to bicycle along attractive bikeways to parks and open space. They especially value greenway paths where they can ride free from the stress of motor traffic.

Among the many actions government could take to improve cycling conditions and promote cycling, the most effective is to create safe, convenient bicycle routes that go where cyclists want to go. According to survey research nationwide, the most commonly cited impediment to increasing bicycle use is the lack of safe bicycle routes. Safe, attractive bicycle routes with reachable destinations are one of the most desirable amenities people seek in a community.

As motor traffic has grown over the last several decades, fewer of Brookline's through streets remain suitable for children or adult "basic" cyclists. [Federal Highway Administration guidelines classify cyclists as *advanced*, *basic*, and *children* (a convenient A, B, C typology). Children cyclists lack the rapid decision-making ability that riding in busy traffic demands. Adult cyclists who are uncomfortable riding with traffic are called "basic" cyclists; those who are not are called "advanced" cyclists.] High traffic streets with wide, complex intersections form barriers that isolate would-be cyclists within their neighborhoods. Often, the integrity of a potential bicycle route is destroyed by a few dangerous links. In such an environment, creating and protecting safe bicycling routes requires deliberate government action and investment.

The high levels of bicycle use in such countries as the Netherlands, Germany, and Denmark and, on our side of the globe, in such places as Davis, California and Boulder, Colorado are not an accident. They are the outcome of a policy of providing cycling routes that are safe for youth as well as adult cyclists by reserving roadway space for bicycle lanes, limiting motor traffic and speed on bicycle routes, and investing in bikeway infrastructure including paths, bridges, and tunnels.

Many other countries, including the U.S., have witnessed a huge drop in the percentage of children bicycling and walking to school. A "Safe Routes to School" movement has arisen to try to reverse this trend. Begun in the 1990s in Australia and adopted widely in the United Kingdom,

it has recently come to Massachusetts with funding through federal transportation legislation. The “Safe Routes to School” philosophy is part of the motivation for this network plan.

Brookline has a good foundation upon which to build a successful bicycle network. Our town’s compactness and location make cycling a practical mode of transportation for many within-town trips and for work trips to nearby employment centers. We have many streets that need relatively little investment to become safe cycling routes. We have the Muddy River paths along the Emerald Necklace, America’s first greenway, and we are close to the extensive Charles River bicycle paths. By American standards, we have a relatively high proportion of our children already walking and cycling to school, and a relatively high share of bicycle use by adults. Brookline is also fortunate to have strong public support for bicycle routes and greenways.

Relation to Other Local Planning Documents

The *Brookline Comprehensive Plan 2005-2015*, recognizes the need for developing a network of safe bicycle routes. Its section on transportation planning recommends that the Town “...prepare a bicycle/pedestrian master plan that outlines a system of connections between neighborhoods, activity centers, and public open spaces. While the *Comprehensive Plan* and other town planning documents describe “bicycle / pedestrian” route plans, route planning for cycling is sufficiently different from route planning for walking that they are usually done separately. As an example, a pedestrian trail linking green spaces might connect Griggs Park to the summits of Corey Hill and Aspinwall Hill using steep public footpaths, something that would never appear in a bicycling network. On the other hand, genuine greenway improvements such as extensions to the Muddy River trails or development of a greenway along Lee Street require joint planning for cycling and walking.

The transportation section of the *Comprehensive Plan* specifically identifies the need for safe bicycle routes across Route 9, stating, “Route Nine will not divide Brookline. The Town will work with all appropriate parties to minimize this division, both physically and in terms of perception, and to make the areas Route Nine passes through more attractive for residents.” The Plan calls for “...improved pedestrian and bicycle crossings at key intersecting streets, such as Chestnut Hill Avenue.”

The *Comprehensive Plan*’s sections on Open Space and Recreation also address the need for bicycle routes, especially those suitable for children and family cycling. It recommends the Town “provide safe and attractive pedestrian and bicycle access Town-wide to all major open space destinations.” It suggests a Brookline Heritage Greenway Trail, “a combined pedestrian and bicycle route to link all major open space, school, pedestrian path, and cultural destinations...” featuring signage and roadway improvements to enhance safety.

Shortly after publication of the *Comprehensive Plan*, the Conservation Commission created a report entitled *Open Space 2005*. One of its goals is that “Brookline will establish a network of open space corridors, including ‘green’ streets with bicycle lanes and pathways that are valued for their environmental, aesthetic and economic benefits.”

The mention of a “network” of corridors suggests that connecting the Town’s open spaces requires not a single trail, but a network of routes. *Open Space 2005* offers a plan of suggested routes that are largely incorporated into this Master Plan.

In 2006, a *Parks, Open Space and Recreation Strategic Master Plan* was prepared for the Department of Public Works Division of Parks and Open Space and the Department of Recreation. It reports that in a survey of Brookline residents, “*more trails and bike paths*” was the third most popular funding priority after acquiring open space and funding park development in general. Based on a thorough needs assessment and consultation process, the report recommends the Town “create bicycle and pedestrian greenways.” It further comments:

Brookline needs to establish a network of open space corridors, including ‘green’ streets with bicycle lanes and pathways that are valued for their environmental, aesthetic and economic benefits. This will not only identify, protect and promote pedestrian and bicycles access routes, but will also improve safety and aesthetics.

The public stressed the need for bicycle and pedestrian routes, access to open space, and greening of roads and bike trails. There are few safe and satisfactory non-vehicular routes, even for intrepid bikers, both in the heavily developed areas of north Brookline and the less dense sections of south Brookline. Moreover, the routes that exist do not connect the public to the Town’s major open space areas. The existing bicycle and pedestrian routes lack a ‘green’ landscape that would provide aesthetically pleasing surroundings and a safe buffer between non-vehicular users and automobile drivers.

Relation to Other Bicycle Route Design Guides

In preparing this Master Plan, the Bicycle Advisory Committee consulted state, federal, and international guidelines for the design of bicycle facilities, and reviewed bicycling master plans for Portland, Oregon, Brunswick, Maine, Long Beach, California, and Denver and Boulder, Colorado. We reviewed Rubel’s *Boston Bike Map* and state bicycle route plans. We also reviewed the literature on bicycle planning and facility design, much of which can be found through the Pedestrian and Bicycle Information Center at the University of North Carolina.

Development of this Network Master Plan

This Master Plan was drafted by the Bicycle Advisory Committee as one of its first actions after the committee was formed in November 2006 to prioritize and justify improvements to particular routes. In spring 2007, input was solicited from the public and Town staff and citizen committees concerned with transportation, parks, open space, and schools.

2. ELEMENTS OF THE NETWORK MASTER PLAN

This Network Master Plan will guide the Town's bicycle facility planning and design. We expect that it will be modified over time to meet evolving conditions. It provides a framework for evaluating particular improvements and for incrementally developing routes that accomplish a community-wide goal that any single route or improvement could not.

This Master Plan has two parts: a *Route Plan* consisting of a network of *designated, signed, and improved* bicycle routes, and policies for route selection, facility design, signage, and implementation. It does not identify specific improvements, but recommends a process for developing improvement plans in accordance with recommended facility design policies.

The *Route Plan*, shown in Figure 1, connects neighborhoods with external destinations. It is complemented by the full set of Brookline's local streets that cyclists can use for within-neighborhood travel and to access the network. The *Route Plan* has two route classes:

- 🚲 *Safe Routes to School*: routes that have a level of separation from traffic appropriate to children and "basic" cyclists. These routes are suitable for children cyclists, and will be most desirable for recreational cycling and for transportation by basic adult cyclists. On the *Route Plan*, they are numbered and shown in non-red colors.
- 🚲 *Adult Cyclist Routes*: routes lacking the separation from traffic needed for most children cyclists, but accommodating either "advanced" cyclists or "basic" cyclists. They are shown on the *Route Plan* in red.

The routes proposed as *Safe Routes* are not necessarily safe for children cyclists in their current condition; it is expected that safety improvements will be made before they are signed or otherwise advertised. Conversely, the designation of some routes as "adult" does not preclude child cyclists from using them. In accordance with Massachusetts law, all cyclists may use any public street except limited access highways.

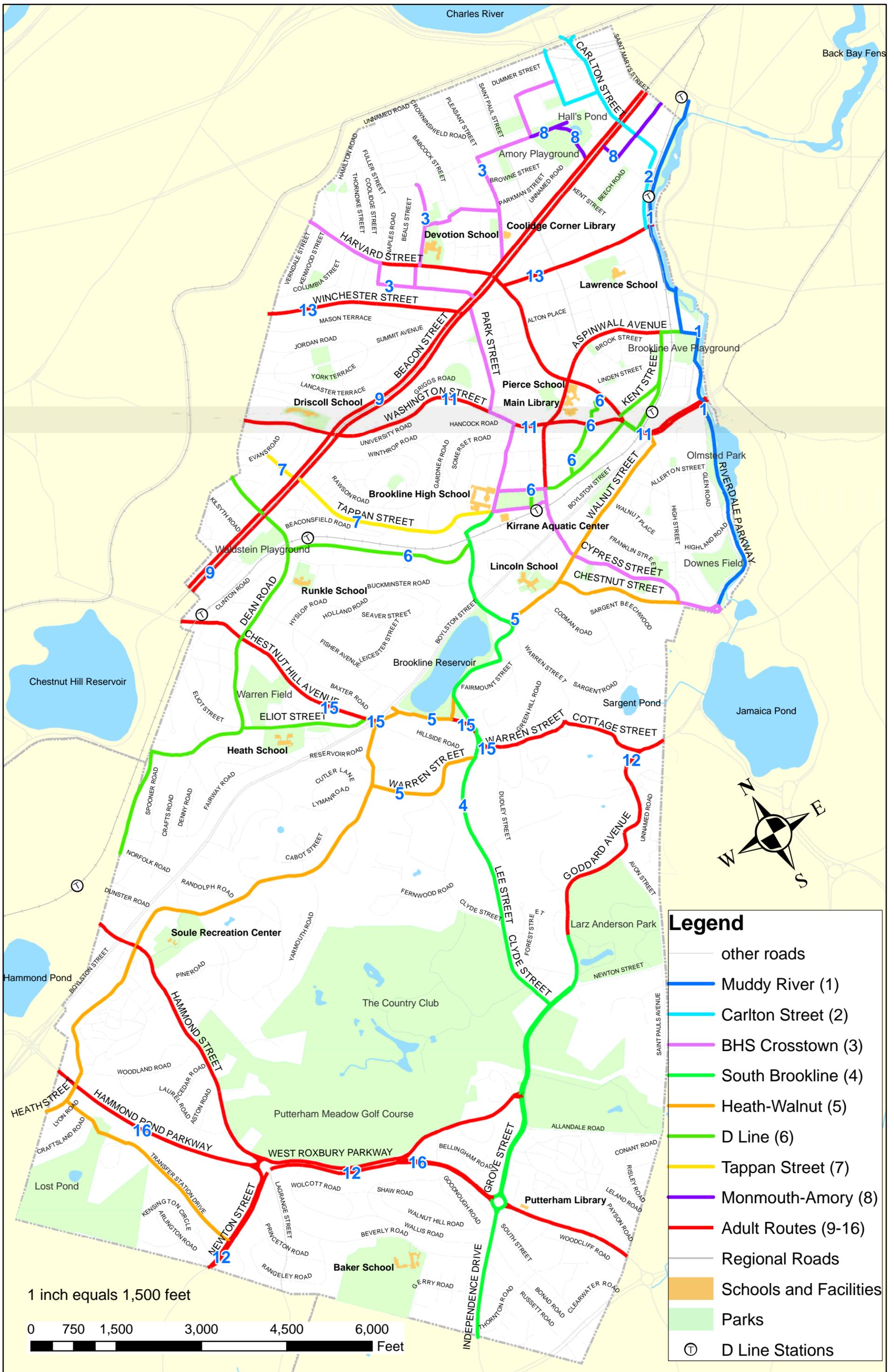


Figure 1. Town Route Plan

3. GOALS AND ROUTE SELECTION

This section describes the Brookline Bicycle Network's three main goals and how they guide route selection and facility design policies.

Goal One: Improve cycling conditions for youth and promote cycling by youth for recreation and for transportation for school, sports, and other purposes.

In order to achieve this goal, the *Route Plan* includes, as a subset, a *Safe Routes to School* network whose routes will have a level of safety appropriate to youth cyclists. The *Safe Routes to School* network, shown in Figure 1 as the set of routes that are not red, includes:

- 🚲 A route from every neighborhood to Brookline High School.
- 🚲 A route from every neighborhood to the Town's swimming pool and to its most heavily used parks, especially those with organized sports for children over 10 years old.
- 🚲 Routes leading toward the Muddy River and toward popular recreational destinations in neighboring communities, namely, the Charles River bike paths, Jamaica Pond, Chestnut Hill Reservoir, and Hammond Pond.

The *Safe Routes to School* network includes eight routes, described in detail in the next section. Of those eight routes, only the South Brookline and Carlton Street routes appear to require substantial roadway improvement to achieve the level of separation from motor traffic appropriate to children cyclists. Since the majority of routes can be implemented with limited expense, the Town can immediately begin to inaugurate much of the *Safe Routes to School* network.

The *Safe Routes to School* network does not explicitly include short-distance routes connecting neighborhoods to local schools. Local school access routes should be developed through each school's participation in the *Safe Routes to School* program, administered by the Massachusetts Executive Office of Transportation's MassRIDES program with funding from the U.S. Department of Transportation. As part of this program, students, teachers, and parents work together to identify safe walking and cycling routes to school, identify needed improvements, and to promote walking and cycling. Unfortunately, high schools are not eligible for *Safe Routes to School* funding. Among the Town's elementary schools, only Devotion School currently participates in this program. Beginning in 2007, federal funds will be available for making street and sidewalk improvements for access to participating schools, creating a stronger incentive for the Town's elementary schools to participate.

Goal Two: Improve conditions for commuting and other adult transportation by bicycle, and promote cycling as a mode of transportation

Adults will enjoy cycling along the *Safe Routes to School* network. However, adults need a more extensive set of routes, particularly to the Town's commercial areas and to employment destinations in neighboring communities.

Therefore, the *Route Plan* includes, in addition to *Safe Routes to School*, a set of *Adult Cyclist Routes* such that, together with *Safe Routes*, provide connections to most significant destinations within and beyond Brookline. *Adult Cyclist Routes* will accommodate as wide a spectrum of cyclist abilities as is practical, subject to available right-of-way, traffic levels, and the needs of competing roadway uses. Depending on those constraints, *Adult Cyclist Routes* may be suitable only for “advanced” cyclists, or may also meet the needs of “basic” cyclists.

In the long run, because cyclists’ travel desire lines are essentially the same as those of motorists, virtually every through street in Town should be part of the *Route Plan*. At this point, however, many routes would not make sense unless neighboring communities continue them beyond our borders (for example, Allandale Road and Lagrange Street). This consideration limits the set of *Adult Cyclist Routes* presented in this Master Plan.

Goal Three: Improve opportunities for individual and family recreational cycling

Cycling is a popular and inexpensive means of recreation and exercise for individuals and families. Serving the needs of recreational cycling means providing pleasant bicycle routes that cross the Town, connect to open space and popular recreation destinations, and that provide a level of separation from motor traffic that makes them appropriate for children and adult “basic” cyclists.

The *Safe Routes to School* network, in addition to providing access to schools, is also designed to meet recreational cycling needs by providing connections to open space destinations in Brookline, to nearby parks such as Jamaica Pond, Hammond Pond, and the Chestnut Hill Reservoir, and to the Paul Dudley White bike paths along the Charles River.

“Advanced cyclists” are also interested in bicycling for recreation. Many of them use Brookline streets for touring (e.g., following part of “State Bicycle Route 1” from Boston to Cape Cod, which runs along Goddard – Newton – Grove - Putterham Circle - West Roxbury Parkway) and for exercise. Many South Brookline streets are ideal for this kind of cycling. One route popular among bicycle enthusiasts is a four-mile circuit around Putterham Meadows, The Country Club and Pine Manor College. For the most part, such riders do not demand roadway improvements, but are interested in bicycle-sensitive maintenance, including sweeping sand and cutting back vegetation (a problem cited for roads bordering the Putterham Meadows Golf Course).

4. ROUTE DESCRIPTIONS

For network planning, although not for public maps or signing, it can be helpful to name or label routes. The routes in the *Route Plan* (Figure 1) are named and described as follows.

Safe Routes to School

1. *Muddy River*: Brookline's greenway route is a major attraction by itself. It links Jamaica Pond with Boston's Longwood, Fenway, and Kenmore districts, and facilitates connections to Carlton Street, the Charles River paths and Cambridge. Within Brookline, it provides access to the Brookline Avenue and Downes parks.

From the Chestnut / Pond rotary to the Boston line near the Landmark Center along the Muddy River. The path from Route 9 to Netherlands Road is yet to be determined.
2. *Carlton Street*: This route connects the Muddy River path to the Charles River bike paths and Cambridge.

From Longwood Ave. (with the Longwood T stop offering a connection to the Muddy River path), along Chapel, Colchester, and Carlton to Commonwealth. Southbound from the BU Bridge, Essex to Ivy to Carlton.
3. *BHS Crosstown*: This is the principal link from Brookline High School to densely populated neighborhoods north and south of the High School. It includes the most important Route 9 crossing in Town for children. This is especially important to keep Route 9 from being a barrier. In North Brookline, it provides connections from Coolidge Corner to Amory Park / Hall's Pond and the BU Bridge.

From the Chestnut / Pond rotary to Brookline High School via Cypress and Davis / Tappan. Then Greenough to Washington to Park. Along Beacon for 150 feet, then cross at Centre. From Centre, one branch continues via Fuller to JFK Crossing (Fuller and Harvard), and then north on Harvard to Verndale. The other branch uses Williams and Stedman (crossing Harvard St.) to the Devotion playground, then across the playground and along Devotion Street to Babcock. Cross onto Dwight to Pleasant to Freeman to Amory (with a connection here to the Amory Park path) to Worthington to Essex. A branch on Pleasant to Beacon Street completes the connection to Coolidge Corner.
4. *South Brookline*: This route links South Brookline with the High School, and via connections there, other destinations across the Town. This route is most in need of roadway improvements because of the need for separation from traffic on Grove, Newton, and Lee Streets. It includes another Route 9 crossing.

From the West Roxbury border along Independence to Putterham Circle, then Grove, Newton, Clyde, Lee, Dudley, Walnut, Warren across Route 9 to Sumner, to Greenough. A branch from Newton / Clyde continues to Larz Anderson Park and Park School via Newton and Goddard.
5. *Heath – Walnut*: This east-west route connects Chestnut Hill, Soule Recreation Center, Pine Manor College, Brookline Reservoir, and Brookline Village. A largely off-road branch through the former landfill connects to the new soccer field and to Newton Street. A branch via Chestnut Street connects to Jamaica Pond and the Muddy River bike path. Connections using other routes make it an important route to Brookline High School.

From the Newton line via Heath to Dudley along the reservoir (approaching Dudley either via Lee or Warren). Then Walnut to Brookline Village. Ideally, the route should continue along Route 9 to the Muddy River. A branch goes down Arlington and through the former landfill site to the new soccer field and Newton Street. Another branch leaves Walnut along Chestnut to Pond.

6. *D Line*: This east-west route connects the Chestnut Hill neighborhood, Brimmer & May School, Warren Field, Brookline High School, Brookline Village, and the Muddy River path. It offers access to Heath and Runkle Schools, and Waldstein and Brookline Avenue parks, and links to local streets in Newton that reach Hammond Pond Reservation and Chestnut Hill Reservoir (via a pedestrian overpass at Reservoir Road). Branches connect to Heath School, the Driscoll school neighborhood, and Town Hall / Pierce School / Main Library. The Eliot Street branch includes the Route 9 crossing at Chestnut Hill Ave. called for in the *Brookline Comprehensive Plan*.

From the Newton line on Middlesex (near the Chestnut Hill T stop and with local street connections to Hammond Pond Reservation) via Middlesex, Reservoir, Dean, Clark, and Sumner to BHS. Then Davis to Harvard, Station / Kent and Kent to Aspinwall to Netherlands to the Muddy River path. Along Cypress Field, going away from the High School, use Tappan to the far side of the playing field, then path across the park to Davis at Dana, then contra-flow on Davis to Cypress. Branches are: Dean/Corey across Beacon Street to Evans; Eliot from Dean to Heath; and Emerson / Thayer from Davis to Washington, then past Town Hall to Pierce Street, ending at Harvard.

7. *Tappan Street*: This route links the Washington Square neighborhood to Brookline High School.

From the Williston / Evans rotary, along Williston, across Beacon to Tappan to BHS.

8. *Monmouth – Amory*: A set of connections from North Brookline to the Muddy River path, the Brookline Arts Center. It provides Muddy River path cyclists a route to Amory Park and Hall’s Pond, and an alternative route to the BU Bridge. It also offers an alternative to Beacon Street for commuters to and from the Fenway area.

From the Boston line at Monmouth to Hawes to Beacon. Along Beacon Street (cyclists going south / east will have to use the sidewalk for a block, which is not ideal, but permissible under state law, since it’s outside a business district) to the Amory Park path to Amory Street, with connections via the *BHS Crosstown Route* (Route 3) to the BU Bridge and the Coolidge Corner area.

Adult Cyclist Routes

9. *Beacon Street*.
10. *Harvard Street*.
11. *Washington Street*, including the Route 9 portion of Washington Street in Brookline Village.
12. *Newton Street – Goddard Avenue*
13. *Winchester – Longwood*.
14. *Cypress – School – Aspinwall*. (The extra traffic lanes and heavy traffic near Washington and Harvard presently preclude making this a *Safe Route*.)
15. *Cleveland Circle to Jamaica Pond*. Via Chestnut Hill Avenue, Lee, Warren, and Cottage.

16. *Putterham – Newton.* West Roxbury Parkway from the Boston line to James Circle; then one branch via Hammond Street, and another via Hammond Parkway to Newton.

5. DESTINATION SIGNAGE

Cities that promote bicycle usage, including cities in Europe as well as Portland (Oregon), Chicago, and Montreal, use *destination signage*, also called *wayfinding signage*, to mark their routes. With destination signage, routes are not named or numbered; rather, they are simply indicated by signs stating where the route goes, along with distance to the destination. An example of destination signage from the Netherlands is shown in Figure 2a; another example, developed in Chicago, is in Figure 2b. The latter is expected to be adopted into the next version of the *Manual on Uniform Traffic Control Devices*. It uses a single sign to convey the same information carried by three signs in the old U.S. standard format (Figure 2c, from Harvard Street).

Destination signs offer the following benefits:

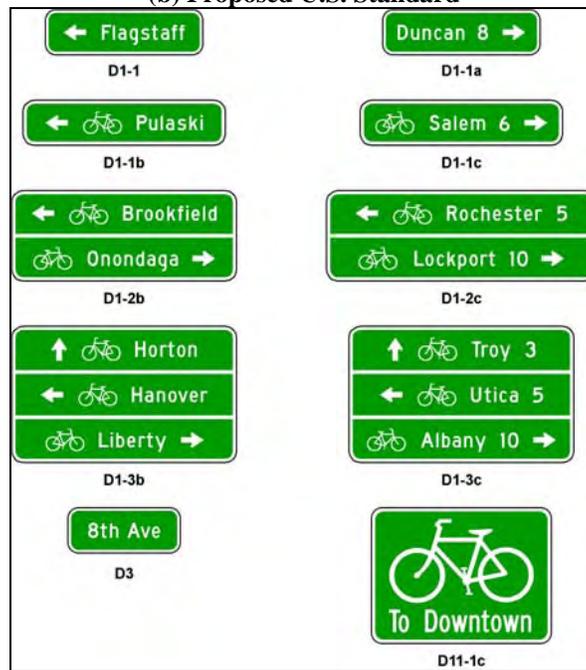
- 🚲 They guide cyclists to safer routes.
- 🚲 They help cyclists find their way, being more helpful than maps once a trip is underway. They are a powerful marketing tool, always advertising the town's bicycle network.
- 🚲 They remind motorists that cyclists are intended road users. Many motorists are not aware that bicycles are allowed on streets, or think that they must stay "out of the way" of cars. Explicit signs and markings help erase this misconception, improving motorist behavior toward cyclists not only on the signed roads, but in general.
- 🚲 They convey the message that our society supports bicycling. That message is important to motorists and to cyclists, and is especially important to potential youth cyclists, who tend to be particularly sensitive to social norms.

Destinations that will appear on signs include neighboring towns and districts (e.g., Longwood Medical Area, Brighton), commercial areas (e.g., Brookline Village, Coolidge Corner), and Brookline High School. It is yet to be determined whether parks and primary schools should be signed as destinations. The signing program will be coordinated with neighboring communities and with statewide and regional bicycle network plans.

**Figure 2: Destination Signs
(a) In the Netherlands**



(b) Proposed U.S. Standard



(c) Old Style Three-Piece Sign (Harvard Street, Brookline)



Source for (a) and (b): "Proposed D1 & D11 Series Bicycle Guide Signs." Technical Committee Recommendation, NCUTCD Bicycle Technical Committee, 6/23/05, revised 1/20/06.

6. POLICIES REGARDING FACILITY DESIGN

Bicycle Accommodation Options

Bicycle accommodation can take several forms, offering different levels of separation from motor traffic. The greater the speed and volume of motor traffic, the more important it is for cyclists to have separation. Forms of bike accommodation include:

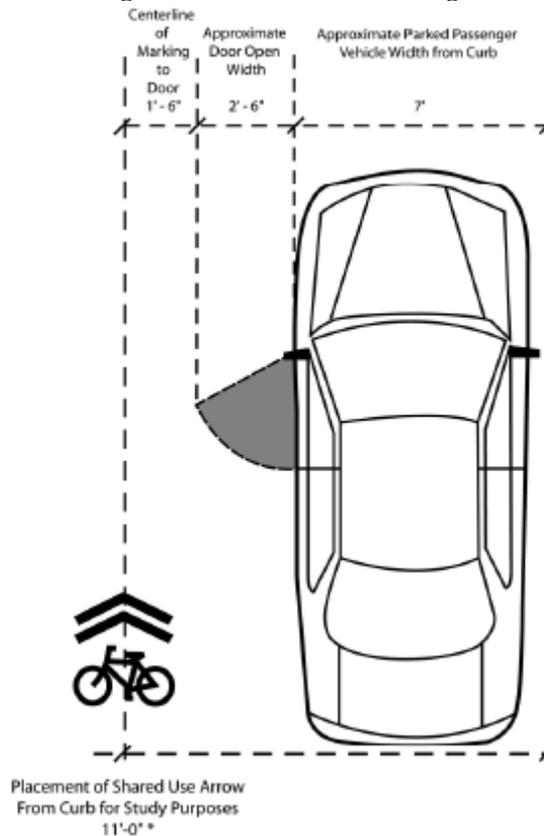
- 🚲 Off-road multi-use path, such as the Muddy River paths.
- 🚲 Sidewalk-level bike paths, called *cycle tracks* in Europe. They run alongside a road at sidewalk level, separated from the sidewalk. Sidewalk-level paths are the preferred means of bicycle accommodation in the Netherlands, Germany, and Denmark, countries with high bicycle use in general and by children in particular. Separation between sidewalk-level bike path and sidewalk may be a planting strip (as along Melnea Cass Boulevard in Boston) or a simple line marking (as in Cambridge along Vassar Street). On road sections with little pedestrian traffic or where a greenway parallels a road, sidewalk-level paths can be multi-use (e.g., shared with pedestrians). Sidewalk-level bike paths can be two-way, running along one side of the road, although one-way paths are usually preferred for safety reasons, especially along streets with a high intersection density. Sidewalk-level bike paths present a hazard at intersections and where they start and end, and therefore should be designed to mitigate that hazard either by regulating conflicts, or by enhancing cyclists' visibility and motorists' expectation of finding an approaching cyclist.
- 🚲 Bike lane. A bike lane is a lane marked and reserved for bicycle use in the road next to the motor traffic lanes, such as on parts of Harvard and Beacon Streets. Along a curb, their width should be at least 4 feet, and preferably 5 feet. Where space is limited, 3-foot informal bike lanes (shoulders without any bicycle lane designation) have been shown to serve cyclists effectively. Where there is parallel parking, bike lanes must extend 13 feet (minimum) to 14 feet (maximum) from the curb. The minimum helps keep cyclists out of the door zone; the maximum discourages double parking.
- 🚲 Wide mixed lanes. These are mixed traffic lanes (i.e., lanes serving both cars and bikes) that are wide enough for most cars, but not necessarily trucks or buses, to pass a cyclist without changing lanes. Standard width is 14 feet from a curb where there is no parallel parking, and 22 feet from a curb where there is parallel parking.
- 🚲 Mixed lanes with overtaking prohibited. On narrow streets with moderate or heavy traffic volumes, prohibiting motorized vehicles from overtaking cyclists eliminates the stress and danger associated with overtaking. A potential site for this treatment is Carlton Street between Beacon and Colchester, where one can often observe cyclists dangerously hugging the curb while motorists timorously seek a passing opportunity. Such a restriction, which would involve an adaptation of the familiar "No Passing" sign to indicate that motorists are not to pass bicyclists, makes cyclists more willing to ride a safe distance from the curb and from parked vehicles without feeling uncomfortable about

hindering motor traffic. In order to prevent a large speed differential when cars approach cyclists, a speed limit of 20 or 25 mph should be posted as well.

- 🚲 Mixed lanes with no special accommodation for bicycles. This default option is appropriate on low speed, low volume streets. With higher speed or higher volume traffic, this form of accommodation serves a narrower range of cyclists.

The safety of mixed lanes can be enhanced by using “Share the Road” markings, as shown in Figure 3. This marking, repeated periodically and centered a safe distance from roadside hazards (11 feet from the curb where there is parallel parking and 3 feet from the curb where there is none), encourages cyclists to stay a safe distance from parked car doors, curbs, and gutter debris. It also helps motorists understand where cyclists are likely to ride, promoting better motorist behavior toward cyclists. Because cyclists often ride too near the door zone (i.e. within range of doors opened suddenly from parked cars), the shared lane marking is especially desirable along parallel parking; however, it can be valuable where there is no parallel parking as well. The shared lane marking, which has about the same meaning as “advisory” bike lanes in the United Kingdom (where they are marked with dashed lines), has been used with success in San Francisco, Denver, and Cambridge, Massachusetts.

Figure 3: Shared Lane Marking



Source: “Proposed Shared Lane Marking (Part 9 of the MUTCD).” Technical Committee Recommendation, NCUTCD Bicycle Technical Committee, 1/7/05, revised 2/18/05.

Criteria for Selecting *Safe Routes to School* Accommodation

Safe Routes to School should have a design that is suitable for children cyclists. At this time, U.S. bicycle facility guides do not offer specific recommendations for accommodating children cyclists, except to say that children prefer off-road paths and quiet local streets. A review of facility selection criteria used by different countries and by different places in the U.S. and Canada (King, 2002) finds, however, a consistent set of criteria for countries where a high proportion of children bike to school such as the Netherlands, Denmark, and Germany. We recommend that *Safe Routes* have one of the following designs, based on driving and cycling norms in the U.S., and the target users children aged 11 to 15:

- 🚲 an off-road path; OR
- 🚲 a sidewalk-level bike path, designed in such a manner as to minimize intersection hazards; OR
- 🚲 a bicycle lane in each direction of travel on a street whose 85th percentile speed is no greater than 32 mph, has less than 14,000 vehicles per day, and has no exclusive right turn lane; OR
- 🚲 mixed lanes (i.e., cyclists use the same lane as cars) with cars prohibited from overtaking cyclists on a two-lane street with 85th percentile speed no greater than 27 mph; OR
- 🚲 no special accommodation (i.e., mixed lanes) on a two-lane street with no more than 4000 vehicles per day whose 85th percentile speed is no greater than 27 mph and that has no right turning lane and little truck or bus traffic.

It is often assumed that local two-lane streets are safe for children's cycling without any special accommodation. This is only true if traffic *volumes* and *speeds* are low, which on many local streets is no longer the case.

On local two-lane streets without a centerline marking (double yellow line), cars tend to ride in the middle of the street when there is no opposing traffic, leaving ample room to overtake a cyclist. However, bicyclists are "squeezed" when a bicycle, an overtaking car, and a car traveling in the opposite direction coincide. Where there is parallel parking, many children and inexperienced cyclists will ride dangerously close to car doors as a way of reducing the anxiety of being overtaken at close distance. The "squeeze" is also inherently dangerous for children cyclists who need a margin of safety for spontaneous changes in direction that might be occasioned, for example, by being suddenly frightened or distracted.

Therefore, for a local two-lane street to be safe for children cyclists, the "overtaking squeeze" has to be substantially eliminated by (a) having bike lanes, (b) prohibiting overtaking, or (c) having sufficiently low traffic speeds and volumes that motorists will wait for a gap in opposing traffic before passing a bicycle. When traffic volumes and speeds are low, the coincidence event (two cars traveling in opposite directions and a bicyclist coinciding) occurs infrequently and lasts for only a few seconds, so that when it occurs, the overtaking motorist is generally willing to slow down and follow the cyclist until traffic in the opposing direction has cleared. When volumes are higher, coincidence occurs more often, and it takes longer for traffic in the opposing direction to clear, making motorists more apt to initiate an overtaking squeeze. The volume criterion recommended, 4,000 vehicles per day, is the cutoff used by the Dutch national design guide.

Preventing the overtaking squeeze also demands that *traffic speed* be low, because at higher speeds motorists are less willing to slow down to the speed of the cyclist (8-12 mph for children cyclists) while waiting for opposing traffic to clear. Low speed also has inherent safety value by increasing a cyclist's margin of safety (making it easier to stay out of a crash), and by lessening the severity of a collision should one occur. The recommended criterion, that 85th percentile speed not exceed 27 mph, is consistent with either a 25 mph posted speed with good compliance, or a 20 mph posted speed with poor compliance. Massachusetts' default ("*prima facie*") speed limit of 30 mph for "thickly settled" areas does not seem compatible with the needs of bicyclist safety on local streets.

Some of the streets in the *Safe Routes* network currently have speeds and / or volumes that exceed the criteria for "no special accommodation." Measures that should be considered to achieve the *Safe Routes* safety criteria include the following.

- 🚲 *Regulations that divert traffic to through streets.* It is generally considered good practice to keep through traffic off local streets. Brookline already uses many traffic restrictions (e.g., one-way streets) to this effect. In many situations, however, there is no practical way to reduce traffic volume on one local street without an opposite effect on another.
- 🚲 *Traffic calming.* Lowering traffic speeds generally requires physical changes to the street that make it uncomfortable to go fast, a principle known as traffic calming. Warnings and lower speed limits by themselves are generally ineffective.
- 🚲 *Prohibit cars from overtaking bicycles.* As mentioned earlier, this treatment applies to two-lane streets with narrow lanes where volumes are high but speeds are low. It has the desirable effect of lowering traffic speeds substantially when bikes are present, while not hindering motor traffic otherwise.
- 🚲 *Provide a bike lane.* Bike lanes, which do not offer physical separation from motor traffic, also have *Safe Routes* speed and volume criteria. They have minimum width requirements to prevent encouraging cyclists from riding too close to parked cars, and so may not fit on some roads without eliminating parallel parking.
- 🚲 *Provide a sidewalk-level bike path.* Because sidewalk-level paths offer physical separation, they can be applied regardless of traffic speed or volume; however, they must be designed in a way that limits their danger at intersections and where the path starts and ends.

Lane Width

Where bicyclist accommodation is in mixed lanes, wider lanes are preferred. There is one exception, however: if a road is to be signed prohibiting cars from overtaking bicycles, lanes should be no wider than 10 feet.

On intersection approaches, mixed lanes should be at least 12 feet wide in order to permit cyclists to pass queued vehicles on the right and advance to the stop line during a red light. Being

in a queue with cars both ahead and behind is not a suitable accommodation for children cyclists, unless there is an overtaking restriction that is well respected.

Wide outside lanes, a form of bicycle accommodation recognized by many U.S. design manual, are not considered an acceptable means of accommodating children cyclists. If there is enough space for a 14-foot lane, research shows that cyclists and motorists alike will be more secure if it is striped instead with a 4-foot bike lane and a 10-foot travel lane (Hallett *et al.*, 2006). If the available width from curb to lane line is 13 feet, it is better to have a 10-foot travel lane and a 3-foot shoulder, which serves as an “informal bike lane,” which has been shown to work well in Florida.

Continuity at Widened Intersection Approaches

Continuity is one of the most critical aspects of effective bicycle route design. One often sees bike lanes disappear at major intersections, just where they are needed the most, in order to fit extra lanes added for traffic capacity and safety. Locally, both Harvard Street and Beacon Street lose bike lanes at different points, often forcing cyclists to choose between riding dangerously close to parked cars and merging into a traffic lane. Even occasional sections of heightened danger can render a bike route inaccessible to many cyclists.

Safe Routes to School must have continuously safe accommodation for children cyclists. The greatest challenge to continuity occurs where local streets cross Beacon Street and Boylston Street, and sometimes at other intersections, where extra lanes are striped to enhance traffic capacity. Often, those extra lanes make the intersection approach uncomfortable and dangerous to cyclists, either because lanes become too narrow, or because of right turn conflicts, or because of the greater complexity of multilane streets. This challenge must be met in order to prevent Beacon Street and Boylston Street from being a barrier.

An example of such a challenge is on Cypress Street southbound approaching Route 9, an important crossing near the high school. An extra lane is striped, which serves as an informal right-turn lane. It is neither signed nor marked as an exclusive lane, but has a right turn arrow and is mostly used for right turning traffic, which is heavy. Because the right lane is used as a right-turn lane, the part of the road where most cyclists feel safe – along the curb – is no longer safe for through-going cyclists due to the conflict with right turning traffic. While in such a situation “advanced” cyclists may be comfortable riding in the middle of the lane, or in the left lane, most cyclists are not, with the effect that there is no place on the road where most cyclists feel safe. One possible solution is to construct a short sidewalk-level bike path on the block approaching the intersection (between Brington Road and Boylston Street), and to control cyclists using this path with the pedestrian signal, which protects cyclists from conflict with right-turning traffic.

Where a bicycle route turns left, especially from streets with multiple lanes, some cyclists will prefer to make two-stage, pedestrian-style left turns. In such situations, it might be appropriate to use markings or other means to guide cyclists. Porter Square, Cambridge offers a good example of guiding cyclists in making a left turn from a curbside bike lane.

Adult Cyclist Route Accommodation

Adult Cyclist Routes should be designed to accommodate as wide a spectrum of cyclists as possible within the constraints of competing roadway needs. The more separation from traffic, the more space provided to cyclists, and the smaller the speed differential between cyclists and motor traffic, the more cyclists will feel safe using a given street.

All the accommodation options mentioned earlier may be considered on adult cyclist routes. Wide outside lanes are generally an inferior option because the same amount of roadway space can be striped instead with a 4-foot bike lane and 10-foot travel lane, resulting in better service for both cyclists and motorists. Sidewalk-level bike paths along high volume streets are only desirable where they can be designed in a manner that provides safety at intersections.

Shared lane markings should be used in connection with mixed lanes where they will improve safety, particularly along parking lanes, and to provide continuity where bike lanes are interrupted, such as along Beacon Street.

Accommodating Contraflow Bicycle Travel

Many of Brookline's one-way streets could better serve cyclists if they were formally made two-way for bicycles by a combination of signing and, where appropriate, marking contraflow bicycle lanes. Many one-way streets such as Netherlands Road and Essex Street between Dummer and Lenox (going south from the BU Bridge) already carry considerable contraflow bicycle traffic. Formally designating such streets for two-way bicycle traffic conveys the message that bikes are welcome, recognized, and given priority on our streets – a valuable message to cyclists, would-be cyclists, and motorists.

Many of Brookline's streets are one-way as part of a deliberate scheme to reduce automobile through traffic. Such streets are often ideal cycling routes for that very reason, which is why the *Route Plan* includes more than a dozen one-way streets on which we anticipate contraflow bicycle use. Putting bike routes along streets that have little traffic due to deliberate traffic restrictions is a general strategy used in several cities in California including Palo Alto and Berkeley, where such streets are called "bike boulevards."

Contraflow lanes are helpful even on streets that are not part of the formal cycling network because they improve access to the network. Cyclists starting or ending their trip on a one-way street would especially like to be able ride in both directions, because cyclists resist making the additional travel loop that one-way streets often demand, especially where blocks are long or terrain is hilly. For example, without a contraflow bicycle lane on Westbourne Terrace, what would otherwise be a one-half block ride to reach Beacon Street from a home on Westbourne Terrace becomes a 3½-block ride around Driscoll School that involves additional uphill travel and a left turn at Washington Square. Most cyclists living on Westbourne now ride the wrong way to avoid the extra travel. Another example is Stedman Street near Devotion School. Many bicyclists currently choose to travel from Devotion Playground by briefly going the wrong way on Stedman rather than going uphill on Stedman, along busy Harvard Street, and back around on Beals Street. The Town should recognize this legitimate need by making these streets two-way for bicycle travel.

The experience of communities regionally, nationally, and around the world show no negative traffic safety effects from contraflow bike lanes on one way streets. Instead, they show several positive impacts. Bicycle traffic moves to less busy side streets, thus taking bikes off the busier main streets; cyclists ride more on the street instead of on sidewalks, as they often do on one-way streets; and there are fewer crashes, as contraflow signs and markings make motorists expect to see bikes going in the other direction. Most communities indicate that signage and road markings determine the success of the program.

Issues to be addressed when considering adding contraflow lanes include whether the roadway is wide enough to reserve a contraflow lane, whether there is parallel parking, dealing with bicycle traffic in the new direction of travel at intersections, and keeping with-flow cyclists from using the contraflow lane. The City of Cambridge has set of guidelines for contraflow lane implementation that may be helpful.

Streets that should be considered for contraflow lane implementation are listed below. The first 15 are part of the *Route Plan*, emphasizing the importance of contraflow travel to bicycling routes in Brookline.

1. Netherlands Road (Aspinwall to Parkway Rd)
2. Park Street (Marion to Beacon)
3. Davis Ave. (Dana to Cypress, to accommodate bikes using the path across Cypress Field that terminates at the corner of Davis and Dana)
4. Greenough Street (Tappan to Davis). Because of how likely it is for motorists to park illegally in a contraflow bike lane at this location, a contraflow sidewalk-level path may be appropriate.
5. Sumner Road (Tappan to Blake)
6. Williams Street / Stedman Street
7. Chestnut Street (Walnut to Kendall)
8. Monmouth Street (Hawes to Carlton)
9. Hawes Street (Beacon to Monmouth)
10. Dudley Street / Dudley Way (Walnut to Lee, along the reservoir)
11. Middlesex Road (Norfolk to Reservoir)
12. Cottage Street (Warren to Goddard)
13. Essex Street (Dummer to Lenox)
14. Dwight Street (the southern branch at the triangular park at Babcock, in order to provide a direct connection to Devotion Street)
15. Heath Street (Holly to Woodland)
16. Westbourne Terrace (Bartlett Crescent to Beacon) and Bartlett Crescent
17. Marion Street (Park to Harvard)

Plantings

Bicycle route development should be accompanied by planting of trees and other greenery where possible. Shade trees make bicycling more pleasant, and greenery makes the street environment more conducive to cycling, walking, and outdoor exercise.

7. POLICIES REGARDING IMPLEMENTATION

These policies are recommended to realize and maintain the routes in the Bicycle Network.

1. The Town, working with the Transportation Board and its Bicycle Advisory Committee, will develop an Improvement Plan for every route in the Route Network, indicating needed safety improvements that might include changes to roadway markings, signs, cross section, parking restrictions, and traffic calming measures. The bicycle accommodation provided should be consistent, for the class of route (*Safe Routes to School* or *Adult Cyclist Route*), with facility design policies of this Master Plan. Because of the large number of routes involved, and because opportunities for implementing changes will be spread over several years, improvement plans will be developed following an “as needed” schedule.
2. The Town will encourage elementary schools in Brookline to participate in the *Safe Routes to School* program, developing as part of that participation a local access network and an Improvement Plan for local streets that provide access to each school.
3. Within a year of the adoption of this Master Plan, the Town will develop and implement a signage plan, including the list of destinations to be included and the location of destination signs with their destinations and distances. Routes will not be signed, however, until appropriate safety improvements have been made.
4. Whenever streets are repaved or reconstructed, improvements needed to realize any part of the *Route Plan*, or any part of a school’s local access plan, or to otherwise provide safe accommodation for cyclists on local streets will be included. Because local streets are vital for access to the Route Network, this provision applies to all Brookline streets. The Transportation Board and its Bicycle Advisory Committee will be provided with advance notice of streets due for repaving and reconstruction so they can develop improvement plans for affected Network Plan routes, and make recommendations for local streets not part of the Network Plan. The Transportation Board and its Bicycle Advisory Committee will also be given advance notice of changes to traffic circulation, street parking, or other matters that might affect bicycle traffic, so they can comment on changes affecting bicycle safety.
5. In order to quickly implement the portion of the bicycling network that can be realized without substantial investment, the Town will include in its annual construction program a “Bicycle Network Improvement Project” consisting of low cost improvements on bike routes that are not likely to be included in the Town’s repaving program in the near future, until there no longer remain sections of the Bicycle Network that can be realized by making low cost improvements. Examples of low cost improvements are markings, signs, adjustments of drain grates, and application of traffic calming measures.
6. The Town will pursue state and federal funding for Bicycle Network implementation, including *Safe Routes to School* funding for portions of the network that serve local school access.

8. ACTION PLAN

This section suggests a schedule for implementing the Network Master Plan, with emphasis on short-term actions.

1. (2006-2008) Rehabilitate Beacon Street with its planned bicycle accommodations. Where possible, make further accommodations as recommended by the Bicycle Advisory Committee, including shared lane markings, stop line setbacks at Coolidge Corner, uniform use of 7-foot wide parking lanes, and curb changes between Park Street and Webster Street in support of the “BHS Crosstown” Route (see item 4 below).
2. (2007) Install signs and markings to explicitly permit contraflow bicycle travel on a pilot set of one-way streets that already carry a significant volume of wrong-way bike traffic. Candidate streets include Netherlands Road, Essex Street, Bartlett Crescent / Westbourne Terrace, Hawes Street, Monmouth Street, and Stedman Street. This aspect of the Network Plan is inexpensive to implement, makes a strong public statement in support of bicycling, and will give the Town valuable experience to guide subsequent contraflow implementations.
3. (2007) Install additional bicycle parking at Brookline High School, other schools, playgrounds, and commercial centers where additional bicycle use is anticipated. This action item can take advantage of the Metropolitan Area Planning Council’s program of reimbursing communities for approved bike rack purchases.
4. (2007-2009) Plan, design, and implement a core subset of the *Safe Routes* network consisting of routes specified below. The following summary anticipates the key improvements that will be needed for each route.
 - 🚲 “BHS Crosstown” (Route 3). Likely improvements for this route include bicycle lanes on Cypress Street from High Street to Tappan Street; a contraflow lane on Park Street (Marion to Beacon); contraflow lanes on Williams and Stedman; rehabilitation of the path through Devotion playground; and contraflow lanes on Dwight (near Babcock) and Essex. Signing and signal adjustments will be needed at intersections involving contraflow lanes. Providing safe crossings of Boylston Street and Beacon Street are challenges that will require careful planning and design. An example given earlier in this plan suggests a possible treatment for the Route 9 crossing, a sidewalk-level bike path on the southbound approach between Brington Road and Boylston Street. At the Beacon Street crossing, a short sidewalk-level bike path on Beacon Street (Park to Webster, south side of Beacon Street) could link Park Street with Centre Street. Measures to lower traffic speeds on Pleasant Street and Park Street may be warranted.
 - 🚲 The central portion of “D Line” (Route 6), from Eliot Street to the High School via Dean, Clark, and Sumner. This route involves a short contraflow lane on Sumner (from Greenough to Blake). A contraflow lane or sidewalk-level path is

needed along Greenough in front of the High School. Little other need for roadway change is anticipated.

- 🚲 “Tappan Street” (Route 7). This route involves a short contraflow lane on Tappan (Blake to Greenough). It may also require modification to the approaches to Beacon Street (to clarify that while cars must turn right, bicycles may cross) and to the Beacon Street crossing to make it safe for both bicycles and pedestrians. Little other need for roadway change is anticipated.
 - 🚲 Monmouth – Amory (Route 8). This route requires contraflow lanes on Monmouth and Hawes, with needed signing and signal adjustments.
 - 🚲 The Muddy River route (Route 1) meets safety criteria already. The missing segment from Route 9 to Netherlands Road is addressed in a later action item.
5. (2007) Incorporate the Walnut / Heath route (Route 5) into the Gateway East project plans by providing a bicycle route from the eastern end of Walnut Street to the Muddy River, most likely by means of a two-way sidewalk-level path from Juniper Street to Pond Ave. along the south side of Route 9.
 6. (2007 onwards) Make bicycle safety improvements to streets as they are repaved.
 7. (2008) As the core network is developed, encourage programs at Brookline High School and other schools to promote bicycle use and safety..
 8. (2008) Initiate planning for the missing link in the Muddy River paths (Route 9 to Netherlands Road), including a Route 9 crossing, and for connections to the Carlton Street and Monmouth Street routes so that the Muddy River can be connected to the Charles River and to Hall’s Pond.
 9. (2008) Initiate planning for the South Brookline route, including consideration of greenway options that serve pedestrian and open space interests as well.
 10. (2008-2009) Plan and implement destination signage on the improved *Safe Routes* and on Adult Cyclist Routes. Careful planning will be needed to ensure a signage system that can grow, that will extend without confusion into neighboring communities, and that will integrate well with signed routes in the region.
 11. (2009) Design and implement the remainder of the *Safe Routes to School* network, except for the South Brookline route.
 12. (2009) Implement other recommended contraflow lanes.
 13. Implement the missing link to the Muddy River path.
 14. Implement the South Brookline route.

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