HARWICH TRAFFIC SAFETY COMMITTEE
HARWICH BIKEWAYS COMMITTEE
HARWICH DISABILITIES RIGHTS COMMITTEE

draft 12/18/10

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

It is the policy of the Massachusetts Department of Transportation to accommodate bicycles and pedestrians into the design and construction of every project. The Cape Cod Commission is currently developing the 2011 Cape Cod Regional Transportation Plan. Goal #3 of the draft plan is to connect village centers, economic and employment centers, and points of interest using multiple coordinated modes of transportation in a direct and efficient manner. ***"Complete Streets"*** are encouraged as a design guideline to accommodate all users including pedestrians, bicyclists, persons in wheelchairs or strollers, public transportation users, and motorists. In order to provide transportation options for Cape Cod residents and visitors to conveniently travel between destinations, each public right of way should be planned, designed, constructed, and/or maintained considering all users for a Complete Street design. A Complete Street design on Cape Cod also considers the environmental and physical context along with local public input.

Chapter 5 of the Plan addresses Bicycle and Pedestrian Planning. In 2010, the Cape Cod Commission re-initiated "Cape Cod Bikeways." A cooperative effort including the Cape Cod National Seashore, the Commission is working with citizens and organizations from across Cape Cod to create a Cape-wide network of bicycling routes. The plan specifically identifies the activities the Commission is involved in with the Harwich Planning Department. As part of an effort to enhance the economic development of Saquatucket Harbor in Harwich Port, the Town of Harwich is seeking to provide safe and effective pedestrian and bicycle facilities between the Cape Cod Rail Trail/Old Colony Rail Trail and Route 28, with a specific focus on a connection between Harwich Center and Harwich Port. In addition, the Town of Harwich is looking to provide safe pedestrian and bicycle connections as well as shuttle bus service between Wychmere Harbor and Saquatucket Harbor. A Cape Cod Commission/Town of Harwich effort is underway to meet the following goals:

- Identify safe and effective pedestrian and bicycle access between the Cape Cod Rail Trail/Old Colony Rail Trail and Route 28, with a specific focus on a connection between Harwich Center and Harwich Port.
- Identify safe and effective pedestrian and bicycle access between Wychmere and Saquatucket Harbors along Route 28 that would intersect with a connection to Harwich Center.
- Identify the potential for shuttle bus service between Wychmere and Saquatucket Harbors.
- Coordinate with the Regional Transportation Plan/Cape Cod Bike Plan. A goal of this effort is to construct new bicycle/pedestrian facilities using available funding sources source is the Cape Cod Transportation Improvement Program (TIP) administered by

the Cape Cod Commission and funded by the Massachusetts Department of Transportation and Federal Highway Administration.

- Commission staff will work with the Town of Harwich to integrate these bicycle/pedestrian efforts into the current update of the RTP.

Massachusetts Highway Department Project Development & Design Guide provides the necessary resource for highway design standards. The Guidebook draws from the state-of-the-art in roadway design. Design guidelines are consistent with those described in the 2004 Edition of *A Policy on the Geometric Design of Highways and Streets by the American Association of State Highway and Transportation Officials* (AASHTO), also known as the "Green Book." The Guidebook also incorporates the additional guidance contained in AASHTO's A *Guide for Achieving Flexibility in Highway Design* (2004), *Guide for the Planning and Design of Pedestrian Facilities* (2004), and *Guide for the Planning and Design of Bicycle Facilities* (1999), as well as the Federal Access Board's *Draft Guidelines for Accessible Right-of-Way* (2002), the Massachusetts Architectural Access Board's *Rules and Regulations* (2005), and the USDA Forest Service's *Outdoor Recreation Accessibility Guidelines* (2005). In addition, research conducted under the auspices of the *Transportation Research Board* (TRB) and other organizations was considered and incorporated into the Guidebook, as appropriate. Finally, best-practices found in the manuals of other states and communities, as well as design guidance formulated specifically for the Guidebook, are included throughout.

Representatives from the Harwich Bikeways, Traffic Safety and Disability Rights Committees have collaborated to research these authoritative standards for the development of safe bikeways and sidewalks for the recreational enjoyment of the residents and visitors of Harwich. The representatives offer these suggestions for consideration in the development of bicycle and pedestrian facilities in Harwich.

Harwich Transportation Plan

These representatives support the adoption of a Town Policy that provides for the maintenance improvement program for town roadways that will accommodate vehicles, bicyclist and pedestrians in accordance with recognized best practices.

Roadway Maintenance Program

The Harwich Highway Capital Maintenance Plan should include as a minimum main roadway improvements that include paved shoulders that would improve access by adult pedestrians and advanced bicycles users. Additional improvements should be scheduled for a planned bicycle and/or pedestrian route system. Operating budgets should reflect costs for routine maintenance (cleaning, trimming, etc.).

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

TYPES OF FACILITIES

Shared Roadways

The roadway should be constructed to accommodate its use by motor vehicles and the Advanced or experienced bicycle rider in two directions (low volume or infrequent pedestrians can walk on the paved roadway in either direction against the vehicle traffic). Designed roadways may need to adjust to additional traffic conditions, such as roundabouts and on street parking. The alternative designs include:

- -a paved vehicle travel lane, typically twelve (12) feet wide with a four (4) foot paved shoulder or five (5) feet with a curbed curbing edge of roadway, or
- -a paved travel lane of fourteen (14) feet to accommodate both vehicles and bicycles [fifteen (15) feet with curbing and/or drainage grates].

Sidewalks

Sidewalks should be constructed on main highways where substantial pedestrian use and infrequent bicycle use by basic adult riders and children is anticipated. The minimum vertical clearance should be eight (8) feet. The width should be five (5) feet for use by pedestrians with low volume basic adult and children bicycle traffic.

Shared Use Path

One ten (10) foot two-way path for substantial shared use by basic adult riders, children and pedestrians should replace a sidewalk. A two (2) foot wide graded area with a maximum 1:6 slope should be maintained on both sides of the path.

In rare instances, a reduced width of eight (8 feet) can be adequate. This reduced width should be used only where the following conditions prevail:

(1) bicycle traffic is expected to be low, even on peak days or during peak hours,

(2) pedestrian use of the facility is not expected to be more than occasional,

(3) there will be good horizontal and vertical alignment providing safe and frequent passing opportunities, and

(4) during normal maintenance activities the path will not be subjected to maintenance vehicle loading conditions that would cause pavement edge damage.

Identify Bicycle Travel Corridors

Predicting bicycle travel corridors for a community is not the same as identifying the routes that bicyclists currently use. Instead, travel corridors can be thought of as "desire lines" connecting neighborhoods that generate bicycling trips with other zones that attract a significant number of bicycling trips. For motor vehicle traffic, most peak morning trips are made between residential neighborhoods and employment centers. In the evening peak, the opposite is true. In the evening or on weekends, the pattern of trip

generation is much more dispersed as people travel to shopping centers, parks, and the homes of friends or relatives. Estimating these trip flows for an entire city can be a complex, time-consuming effort requiring significant amounts of raw data and sophisticated computer models. Fortunately, transportation planning for bicycles is much simpler. Unlike traditional transportation planning that attempts to predict travel demands between future zones on as-yet-unbuilt streets and highways, bicycle planning attempts to provide for bicycle use based on existing land uses assuming that the present impediments to bicycle use are removed. These desire lines are, in fact, well represented by the traffic flow on the existing system of streets and highways. The underlying assumption is that people on bikes want to go to the same places as do people in cars (within the constraints imposed by distance), and the existing system of streets and highways reflects the existing travel demands of the community. Furthermore, most adults have a mental map of their community based on their experience as motor vehicle operators. Thus, they tend to orient themselves by the location of major streets and highways. Therefore, a good way to estimate desire lines for bicyclists and to project bicycle trips is based on the existing pattern of motor vehicle flows. The simplest way to do this is to multiply the annual Average Daily Traffic (AADT) of each segment of the road system by the bicycle mode split (the percentage of all trips that are made by bicycle) for the community or region. For the first time, the 1990 census will provide bicycle mode splits for census tracts and entire communities. Mode split estimates of total trips by bicycle in American cities have ranged between 3 and 11 percent. Again, it is important to note that the resulting map may not be a representation of where cyclists are now, but is instead a reflection of where bicyclists wish to go. The actual travel patterns of group B/C cyclists are heavily influenced by their perception of the bicycling environment they face. Uncomfortable or threatening bicycling conditions will cause these bicyclists to alter route choice from their most preferred alignment, choose a different travel mode, or not make the trip at all. Thus, the task of the transportation planner for bicycling is to ask, "Where are the bicyclists now?" and "Where would they be if they could go where they preferred?" Although this use of existing traffic flows is a useful overall predictor of bicyclists' desire lines, a few special situations may require adjustments to the corridor map:

• Schools—especially colleges and universities—and military bases can generate a disproportionately large share of bicycle trips. This is especially true for campuses where motor vehicle parking is limited.

• Parks, beaches, libraries, greenways, rivers and lakesides, scenic roads, and other recreational facilities attract a proportionately higher percentage of bicycle trips.

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The authoritative resources used in these recommendations are listed at the end of this report. Excerpts primarily from the Guide for the Development of Bicycle Facilities prepared by the American Association of State Highway and Transportation 0fficials (AASHTO) are offered to provide some rational for our recommendations.

DEFINITIONS

BICYCLE -Every vehicle propelled solely by human power upon which any person may ride, having two tandem wheels, except scooters and similar devices. The term "bicycle" for this publication also includes three and four-wheeled human-powered vehicles, but not tricycles for children.

BICYCLE FACILITIES -A general term denoting improvements and provisions made by public agencies to accommodate or encourage bicycling, including parking and storage facilities, and shared roadways not specifically designated for bicycle use.

BICYCLE LANE or BIKE LANE -A portion of a roadway which has been designated by striping, signing and pavement markings for the preferential or exclusive use of bicyclists.

BICYCLE PATH or BIKE PATH -See Shared Use Path.

BICYCLE ROUTE SYSTEM -A system of bikeways designated by the jurisdiction having authority with appropriate directional and informational route markers, with or without specific bicycle route numbers. Bike routes should establish a continuous routing, but may be a combination of any and all types of bikeways.

BIKEWAY -A generic term for any road, street, path or way which in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.

HIGHWAY -A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

RAIL–TRAIL -A shared use path, either paved or unpaved, built within the right-of-way of an existing or former railroad.

RIGHT-OF-WAY -A general term denoting land, property or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

RIGHT OF WAY -The right of one vehicle or pedestrian to proceed in a lawful manner in preference to another vehicle or pedestrian.

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ROADWAY -The portion of the highway, including shoulders, intended for vehicular use.

RUMBLE STRIPS -A textured or grooved pavement sometimes used on or along shoulders of highways to alert motorists who stray onto the shoulder.

SHARED ROADWAY -A roadway which is open to both bicycle and motor vehicle travel. This may be an existing roadway, street with wide curb lanes, or road with paved shoulders.

SHARED USE PATH -A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users.

SHOULDER -The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of sub-base, base and surface courses.

SIDEWALK -The portion of a street or highway right-of-way designed for preferential or exclusive use by pedestrians.

SIGNED SHARED ROADWAY (SIGNED BIKE ROUTE) -A shared roadway which has been designated by signing as a preferred route for bicycle use.

TRAVELED WAY -The portion of the roadway for the movement of vehicles, exclusive of shoulders.

UNPAVED PATH -Paths not surfaced with asphalt or Portland cement concrete.

ADDITIONAL INFORMATION

The Bicycle

Bicyclists require at least 1.0 m (40 inches) of essential operating space based solely on their profile. An operating space of 1.2 m (4 feet) is assumed as the minimum width for any facility designed for exclusive or preferential use by bicyclists. Where motor vehicle traffic volumes, motor vehicle or bicyclist speed, and the mix of truck and bus traffic increase, a more comfortable operating space of 1.5 m (5 feet) or more is desirable.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

The Bicycle User

Although their physical dimensions may be relatively consistent, the skills, confidence and preferences of bicyclists vary dramatically. Some riders are confident riding anywhere they are legally allowed to operate and can negotiate busy and high speed roads that have few, if any, special accommodations for bicyclists. Most adult riders are less confident and prefer to use roadways with a more comfortable amount of operating space, perhaps with designated space for bicyclists, or shared use paths that are away from motor vehicle traffic. Children may be confident riders and have excellent bike handling skills, but have yet to develop the traffic sense and experience of an everyday adult rider. All categories of rider require smooth riding surfaces with bicycle-compatible highway appurtenances, such as bicycle-safe drainage inlet grates. A 1994 report by the Federal Highway Administration11 used the following general categories of bicycle user types (A, B and C) to assist highway designers in determining the impact of different facility types and roadway conditions on bicyclists:

- **A**dvanced or experienced riders are generally using their bicycles as they would a motor vehicle. They are riding for convenience and speed and want direct access to destinations with a minimum of detour or delay. They are typically comfortable riding with motor vehicle traffic; however, they need sufficient operating space on the traveled way or shoulder to eliminate the need for either themselves or a passing motor vehicle to shift position.

- **B**asic or less confident adult riders may also be using their bicycles for transportation purposes, e.g., to get to the store or to visit friends, but prefer to avoid roads with fast and busy motor vehicle traffic unless there is ample roadway width to allow easy overtaking by faster motor vehicles. Thus, basic riders are comfortable riding on neighborhood streets and shared use paths and prefer designated facilities such as bike lanes or wide shoulder lanes on busier streets.

- **C**hildren, riding on their own or with their parents, may not travel as fast as their adult counterparts but still require access to key destinations in their community, such as schools, convenience stores and recreational facilities. Residential streets with low motor vehicle speeds, linked with shared use paths and busier streets with well-defined pavement markings between bicycles and motor vehicles, can accommodate children without encouraging them to ride in the travel lane of major arterials

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

CHOOSING THE APPROPRIATE FACILITY

These three bicycle user types are a helpful guide to the highway designer. However, no one type of bicycle facility or highway design suits every bicyclist and no designated bicycle facility can overcome a lack of bicycle operator skill. Within any given transportation corridor, bicyclists may be provided with more than one option to meet the travel and access needs of all potential users. Planners and engineers should recognize that the choice of highway design will affect the level of use, the types of user that can be expected to use any given road, and the level of access and mobility that is afforded bicyclists. For example, a four-lane divided highway with 3.6-m (12-foot) travel lanes, no shoulder and an 85 km/hr (55 mph) speed limit will attract only the most confident of riders. The same road with a 1.5-m (5-foot) shoulder or bike lane might provide sufficient "comfortable operating space" for many more adult riders, but would still not be comfortable for children or less confident adults. This latter group might only be accommodated through an alternative route using neighborhood streets linked by short sections of shared use path. If such an alternative route is provided and the four-lane road has a continuous paved shoulder, most experienced and many casual adult riders will continue to use the shoulder for the sake of speed and convenience. Facilities for bicyclists should also be planned to provide continuity and consistency for all users. Children using a path to get to school should not have to cross a major arterial without some intersection controls, and shoulders and bike lanes should not end abruptly and unannounced at a difficult intersection or busy stretch of highway.

TYPES OF BICYCLE FACILITIES

Selection of a bicycle facility type is dependent on many factors, including the ability of the users, specific corridor conditions and facility cost. The descriptions below provide an overview of each facility type and general design.

Shared Roadway (No Bikeway Designation). Most bicycle travel in the United States now occurs on streets and highways without bikeway designations. This probably will be true in the future as well. In some instances, a community's existing street system may be fully adequate for efficient bicycle travel, and signing and striping for bicycle use may be unnecessary. In other cases, some streets and highways may be unsuitable for bicycle travel at present, and it would be inappropriate to encourage bicycle travel by designating the routes as bikeways. Finally, some routes may not be considered high bicycle demand corridors, and it would be inappropriate to designate them as bikeways regardless of roadway conditions (e.g., minor residential streets). Some rural highways are used by touring bicyclists for intercity and recreational travel. In most cases, such routes should only be designated as bikeways where there is a need for enhanced

continuity with other bicycle routes. However, the development and maintenance of 1.2-m (4-foot) paved shoulders with a 100-mm (4-inch) edge stripe can significantly improve the safety and convenience of bicyclists and motorists along such routes.

Signed Shared Roadway. Signed shared roadways are designated by bike route signs, and serve either to:
a. Provide continuity to other bicycle facilities (usually Bike Lanes); or
b. Designate preferred routes through high-demand corridors.
As with bike lanes, signing of shared roadways should indicate to bicyclists that particular advantages exist to using these routes compared with alternative routes. This means that responsible agencies have taken actions to assure that these routes are suitable as shared routes and will be maintained in a manner consistent with the needs of bicyclists. Signing also serves to advise vehicle drivers that bicycles are present.

Bike Lane or Bicycle Lane. Bike lanes are established with appropriate pavement markings and signing along streets in corridors where there is significant bicycle demand and where there are distinct needs that can be served by them. The purpose should be to improve conditions for bi-cyclists on the streets. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. Bike lanes also help to increase the total capacities of highways carrying mixed bicycle and motor vehicle traffic. Another important reason for constructing bike lanes is to better accommodate bicyclists where insufficient space exists for comfortable bicycling on existing streets. This may be accomplished by reducing the width of vehicular lanes or prohibiting parking in order to delineate bike lanes. In addition to lane striping, other measures should be taken to ensure that bicycle lanes are effective facilities. In particular, bicycle-safe drainage inlet grates should be used, pavement surfaces should be smooth, and traffic signals should be responsive to bicyclists. Regular maintenance of bicycle lanes should be a top priority, since bicyclists are unable to use a lane with potholes, debris or broken glass. If bicycle travel is to be improved, special efforts should be made to assure that a high quality network is provided with these lanes. However, the needs of both the motorist and the bicyclist must be considered in the decision to provide bike lanes.

Shared Use Path. Generally, shared use paths should be used to serve corridors not served by streets and highways or where wide utility or former railroad right-of-way exists, permitting such facilities to be constructed away from the influence of parallel streets. Shared use paths should offer opportunities not provided by the road system. They can provide a recreational opportunity or, in some instances, can serve as direct

commute routes if cross flow by motor vehicles and pedestrians is minimized. The most common applications are along rivers, ocean fronts, canals, utility rights-of-way, former or active railroad rights-of-way, within college campuses, or within and between parks. There may also be situations where such facilities can be provided as part of planned developments. Another common application of shared use paths is to close gaps in bicycle travel caused by construction of cul-de-sacs, railroads and freeways or to circumvent natural barriers (rivers, mountains, etc.). While shared use paths should be designed with the bicyclist's safety in mind, other users such as pedestrians, joggers, dog walkers, people pushing baby carriages, persons in wheelchairs, skate boarders, in-line skaters and others are also likely to use such paths. In selecting the proper facility, an overriding concern is to assure that the proposed facility will not encourage or require bicyclists or motorists to operate in a manner that is inconsistent with the rules of the road. The needs of both motorists and bicyclists must be considered in selecting the appropriate type of facility. An important consideration in selecting the type of facility is continuity. Alternating segments of shared use paths and bike lanes along a route are generally inappropriate and inconvenient because street crossings by bicyclists may be required when the route changes character. Also, wrong-way bicycle travel with a higher potential for crashes may occur on the street beyond the ends of shared use paths because of the inconvenience of having to cross the street.

Sidewalks generally are not acceptable for bicycling. However, in a few limited situations, such as on long and narrow bridges and where bicyclists are incidental or infrequent users, the sidewalk can serve as an alternate facility, provided any significant difference in height from the roadway is protected by a suitable barrier between the sidewalk and roadway.

The following information was extracted from the Massachusetts Highway Department Project Development & Design Guide.

Off Road and Shared Use Paths

A ***shared use path*** is a dedicated facility for pedestrians, bicyclists, roller bladers, etc. Although sidewalks are generally preferred, off-road paths are sometimes suitable in rural and suburban low-density areas. The path should provide the same connectivity as the roadway but can be set back from the roadway and its route can deviate around sensitive environmental areas. Off-road paths must comply with 521 CMR. Depending on their location to the roadway, these off-road paths may need to meet 521 CMR's "walkway" regulations as opposed to its "sidewalk" regulations. The slope of sidewalks can follow that of the natural terrain, but the slope of walkways is limited to 5 percent. A

walkway that has slopes between 5 percent and 8.3 percent is permitted, but it must meet 521 CMR's ramp requirements for handrails and rest areas. A walkway that is not along a vehicular way can not have a slope exceeding 5 percent in the build environment. A ramp can not have a slope exceeding 8.3 percent. This is discussed in detail in Chapter 6. The U.S. Access Board guidelines presented in its proposed *Guidelines for Outdoor Developed Areas* provide additional information on the design of paths. The design standards for off-road paths and trails are presented in Chapter 11.

Chapter 3 -Basic Design Controls: 3.3.1 The Pedestrian

When thinking about likely pedestrian travel between activity centers (i.e., residence to school, parking to store, etc.), distance is the primary factor in the initial decision to walk. Most people are willing to walk 5 to 10 minutes at a comfortable pace to reach a destination, which equates to a distance of about 0.2 to 0.4 mile. Although longer walking trips are possible, a trip of 1.0 mile is generally the longest distance that most people are willing to walk on a regular basis. The designer should ensure that pedestrian network connectivity and safe crossings are provided between activity centers. In addition to the characteristics described above, the spatial dimensions of pedestrians and their operating characteristics are key critical aspects that influence the detailed design elements of pedestrian facilities.

A simplified body ellipse of 2 by 1.5 feet with a total area of 3 square feet is used as the basic space for a single pedestrian. This represents the practical minimum space required for standing pedestrians. The clear space for a person sitting stationary in a wheelchair is generally understood to be 2.5 feet by 4 feet, although people using scooters and power chairs may require even more space. A person using crutches, a service animal, or a walker typically requires 36 inches clear width. In evaluating a pedestrian facility, an area of 8.0 square feet is typically considered to allow a buffer zone for each pedestrian and approximately twice that is needed for a person using a wheelchair or a white cane. These dimensions indicate that a 3 foot pathway is adequate for single file pedestrian flow in one direction, in the absence of vertical obstructions along the route. To allow free passing of pedestrians, a walkway that is at least five-feet wide and clear of obstructions is required. Walking is often a social activity, and frequently pedestrians walk in pairs or groups. To account for this common behavior, it may be desirable to design facilities that enable two people to walk or ride their chair abreast, requiring approximately 6 feet of width. In areas with high pedestrian traffic, greater widths are desirable as described in Chapter 5.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

DESIGN

Shared Roadways

To varying extent, bicycles will be used on all highways where they are permitted. Bicycle-safe design practices, as described in this guide, should be followed during initial roadway design to avoid costly subsequent improvements. Because most existing highways have not been designed with bicycle travel in mind, roadways can often be improved to more safely accommodate bicycle traffic. Design features that can make roadways more compatible to bicycle travel include bicycle-safe drainage grates and bridge expansion joints, improved railroad crossings, smooth pavements, adequate sight distances, and signal timing and detector systems that respond to bicycles. In addition, more costly shoulder improvements and wide curb lanes can be considered. Also see Chapter 2, Other Design Considerations.

Width is the most critical variable affecting the ability of a roadway to accommodate bicycle traffic. In order for bicycles and motor vehicles to share the use of a roadway without compromising the level of service and safety for either, the facility should provide sufficient paved width to accommodate both modes. This width can be achieved by providing wide outside lanes or paved shoulders.

Paved Shoulders

Adding or improving paved shoulders often can be the best way to accommodate bicyclists in rural areas and benefit motor vehicle traffic. Paved shoulders can extend the service life of the road surface since edge deterioration will be significantly reduced. Paved shoulders also provide a break-down area for motor vehicles. Where funding is limited, adding or improving shoulders on uphill sections will give slow-moving bicyclists needed maneuvering space and will decrease conflicts with faster moving motor vehicle traffic. Paved shoulders should be at least 1.2 m (4 feet) wide to accommodate bicycle travel. However, where 1.2-m (4-foot) widths cannot be achieved, any additional shoulder width is better than none at all. The measurement of usable shoulder width should not include the width of a gutter pan, unless the pan width is 1.2 m (4 feet) or greater. Shoulder width of 1.5 m (5 feet) is recommended from the face of guardrail, curb or other roadside barriers. It is desirable to increase the width of shoulders where higher bicycle usage is expected. Additional shoulder width is also desirable if motor vehicle speeds exceed 80 km/h (50 mph), or the percentage of trucks, buses and recreational vehicles is high, or if static obstructions exist at the right side of the roadway. In general, AASHTO's recommendations for shoulder width (as described in A Policy on Geometric Design of Highways and Streets (Green Book 1)) are the best guide for bicycles as well, since wider shoulders are recommended on heavily traveled

and high-speed roads and those carrying large numbers of trucks. However, in order to be usable by bicyclists the shoulder must be paved. Rumble strips or raised pavement markers, where installed to discourage or warn motorists they are driving on the shoulder, are not recommended where shoulders are used by bicyclists unless there is a minimum clear path of 0.3 m (1 foot) from the rumble strip to the traveled way, 1.2 m (4 feet) from the rumble strip to the outside edge of paved shoulder, or 1.5 m (5 feet) to adjacent guardrail, curb or other obstacle. If existing conditions preclude achieving the minimum desirable clearance, the width of the rumble strip may be decreased or other appropriate alternative solutions should be considered.

Increased Lane Width

Wide curb lanes for bicycle use are usually preferred where shoulders are not provided, such as in restrictive urban areas. On highway sections without designated bikeways, an outside or curb lane wider than 3.6 m (12 feet) can better accommodate both bicycles and motor vehicles in the same lane and thus is beneficial to both bicyclists and motorists. In many cases where there is a wide curb lane, motorists will not need to change lanes to pass a bicyclist. Also, a wide curb lane provides more maneuvering room when drivers are exiting from driveways or in areas with limited sight distance. In general, 4.2 m (14 feet) of usable lane width is the recommended width for shared use in a wide curb lane. Usable width normally would be from edge stripe to lane stripe or from the longitudinal joint of the gutter pan to lane stripe (the gutter pan should not be included as usable width). On stretches of roadway with steep grades where bicyclists need more maneuvering space, the wide curb lane should be slightly wider where practicable [4.5 m (15 feet) is preferred]. The 4.5-m (15-foot) width may also be necessary in areas where drainage grates, raised reflectors on the right-hand side of the road, or on-street parking effectively reduce the usable width. With these exceptions in mind, widths greater than 4.2 m (14 feet) that extend continuously along a stretch of roadway may encourage the undesirable operation of two motor vehicles in one lane, especially in urban areas, and therefore are not recommended. In situations where more than 4.5 m (15 feet) of pavement width exists, consideration should be given to striping bike lanes or shoulders. Restriping to provide wide curb lanes may also be considered on some existing multi-lane facilities by making the remaining travel lanes and left-turn lanes narrower. This should only be considered after careful review of traffic characteristics along the corridor and supported by a documented engineering analysis based on applicable design criteria.

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Signed Shared Roadways

Signed shared roadways are those that have been identified by signing as preferred bike routes. There are several reasons for designating signed bike routes:

a. The route provides continuity to other bicycle facilities such as bike lanes and shared use paths.

b. The road is a common route for bicyclists through a high demand corridor.

c. In rural areas, the route is preferred for bicycling due to low motor vehicle traffic volume or paved shoulder availability.

d. The route extends along local neighborhood streets and collectors that lead to an internal neighborhood destination such as a park, school or commercial district.

Bike route signs may also be used on streets with bike lanes, as well as on shared use paths. Regardless of the type of facility or roadway where they are used, it is recommended that bike route signs include destination information.

Signing of shared roadways indicates to cyclists that there are particular advantages to using these routes compared to alternate routes. This means the responsible agencies have taken action to ensure these routes are suitable as shared routes and will be maintained. The following criteria should be considered prior to signing a route:

a. The route provides through and direct travel in bicycle-demand corridors.

b. The route connects discontinuous segments of shared use paths, bike lanes and/or other bike routes.

c. An effort has been made to adjust traffic control devices (e.g., stop signs, signals) to give greater priority to bicyclists on the route, as opposed to alternative streets. This could include placement of bicycle-sensitive detectors where bicyclists are expected to stop.

d. Street parking has been removed or restricted in areas of critical width to provide improved safety.

e. A smooth surface has been provided (e.g., adjust utility covers to grade, install bicycle-safe drainage grates, fill potholes, etc.)

f. Maintenance of the route will be sufficient to prevent accumulation of debris (e.g., regular street sweeping).

g. Wider curb lanes are provided compared to parallel roads.

h. Shoulder or curb lane widths generally meet or exceed width requirements included under Shared Roadways.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

In general, the designated use of sidewalks (as a signed shared facility) for bicycle travel is unsatisfactory. (See Undesirability of Sidewalks as Shared Use Paths.) It is important to recognize that the development of extremely wide sidewalks does not necessarily add to the safety of sidewalk bicycle travel, since wide sidewalks encourage higher speed bicycle use and increase potential for conflicts with motor vehicles at intersections, as well as with pedestrians and fixed objects. Sidewalk bikeways should be considered only under certain limited circumstances, such as:

a. To provide bikeway continuity along high speed or heavily traveled roadways having inadequate space for bicyclists, and uninterrupted by driveways and intersections for long distances.
b. On long, narrow bridges. In such cases, ramps should be installed at the sidewalk approaches. If approach bikeways are two-way, sidewalk facilities also should be two-way. Whenever sidewalk bikeways are established, unnecessary obstacles should be removed. Whenever bicyclists are directed from signed shared roadways to sidewalks, curb cuts should be flush with the street to assure that bicyclists are not subjected to problems associated with crossing a vertical lip at a flat angle. Curb cuts at every intersection are necessary, as well as bikeway yield or stop signs at uncontrolled intersections. Curb cuts should be wide enough to accommodate adult tricycles and two-wheel bicycle trailers. In residential areas, sidewalk riding by young children is common. With lower bicycle speeds and lower cross street auto speeds, potential conflicts are somewhat lessened, but still exist. Nevertheless, this type of sidewalk bicycle use is accepted. It is inappropriate to sign these facilities as bicycle routes. In general, bicyclists should not be encouraged through signing to ride facilities that are not designed to accommodate bicycle travel.

Designating Sidewalks as Signed Bikeways

In general, the designated use of sidewalks (as a signed shared facility) for bicycle travel is unsatisfactory. (See Undesirability of Sidewalks as Shared Use Paths.) It is important to recognize that the development of extremely wide sidewalks does not necessarily add to the safety of sidewalk bicycle travel, since wide sidewalks encourage higher speed bicycle use and increase potential for conflicts with motor vehicles at intersections, as well as with pedestrians and fixed objects. Sidewalk bikeways should be considered only under certain limited circumstances, such as:

a. To provide bikeway continuity along high speed or heavily traveled roadways having inadequate space for bicyclists, and uninterrupted by driveways and intersections for long distances.
b. On long, narrow bridges. In such cases, ramps should be installed at the sidewalk

approaches. If approach bikeways are two-way, sidewalk facilities also should be two-way.

Whenever sidewalk bikeways are established, unnecessary obstacles should be removed. Whenever bicyclists are directed from signed shared roadways to sidewalks, curb cuts should be flush with the street to assure that bicyclists are not subjected to problems associated with crossing a vertical lip at a flat angle. Curb cuts at every intersection are necessary, as well as bikeway yield or stop signs at uncontrolled intersections. Curb cuts should be wide enough to accommodate adult tricycles and two-wheel bicycle trailers. In residential areas, sidewalk riding by young children is common. With lower bicycle speeds and lower cross street auto speeds, potential conflicts are somewhat lessened, but still exist. Nevertheless, this type of sidewalk bicycle use is accepted. It is inappropriate to sign these facilities as bicycle routes. In general, bicyclists should not be encouraged through signing to ride facilities that are not designed to accommodate bicycle travel.

Signing of Shared Roadways

For Shared The Road signs to be more functional, supplemental destination plates should be placed beneath them when located along routes leading to high demand destinations (e.g., “To Downtown”, “To State College”, etc.).

There are instances where it is necessary to sign a route to direct bicyclists to a logical destination; however, the route does not offer any of the above signed shared roadway criteria. In such cases, the route should not be signed as a bike route, although destination signing may be advisable. A typical application of destination signing would be where bicyclists are directed off a highway to bypass a section of freeway. Special signs would be placed to guide bicyclists to the next logical destination, much as motorists would be directed if a highway detour were required. In urban areas, signs typically would be placed every 500 m (approximately every 1/4 mile), at all turns, and at major signalized intersections.

Bike Lanes

Bike lanes can be incorporated into a roadway when it is desirable to delineate available road space for preferential use by bicyclists and motorists, and to provide for more predictable movements by each. Bike lane markings can increase a bicyclist’s confidence in motorists not straying into their path of travel. Likewise, passing motorists are less likely to swerve to the left out of their lane to avoid bicyclists on their right. Also see Chapter 2, Other Design Criteria, for additional information which applies to bike lanes. Drainage grates, railroad crossings, traffic control devices, etc., need to be evaluated and upgraded if necessary for bicycle use. Bike lanes should be one-way

facilities and carry bike traffic in the same direction as adjacent motor vehicle traffic. Two-way bike lanes on one side of the roadway are not recommended when they result in bicycles riding against the flow of motor vehicle traffic. Wrong-way riding is a major cause of bicycle crashes and violates the rules of the road as stated in the UVC 3. Bicycle-specific wrong-way signing may be used to discourage wrong-way travel. However, there may be special situations where a two-way bike lane for a short distance can eliminate the need for a bicyclist to make a double crossing of a busy street or travel on a sidewalk.

This should only be considered after careful evaluation of the relative risks and should be well documented in the project file. On one-way streets, bike lanes should generally be placed on the right side of the street. Bike lanes on the left side are unfamiliar and unexpected for most motorists. This should only be considered when a bike lane on the left will substantially decrease the number of conflicts, such as those caused by heavy bus traffic or unusually heavy turning movements to the right, or if there are a significant number of left-turning bicyclists. Thus, left-side bike lanes should only be considered after careful evaluation. Similarly, two-way bike lanes on the left side of a one-way street could be considered with a suitable separation from the motor vehicle traffic after a complete engineering study of other alternatives and relative risks.

Bike Lane Widths

For roadways with no curb and gutter, the minimum width of a bike lane should be 1.2 m (4 feet). If parking is permitted, as in Figure 6(1), the bike lane should be placed between the parking area and the travel lane and have a minimum width of 1.5 m (5 feet). Where parking is permitted but a parking stripe or stalls are not utilized, the shared area should be a minimum of 3.3 m (11 feet) without a curb face and 3.6 m (12 feet) adjacent to a curb face as shown in Figure 6(2). If the parking volume is substantial or turnover is high, an additional 0.3 to 0.6 m (1 to 2 feet) of width is desirable.

Bike lanes should never be placed between the parking lane and curb lane. Bike lanes between the curb and parking lane can create obstacles for bicyclists from opening car doors and poor visibility at intersections and driveways and they prohibit bicyclists from making left turns. The recommended width of a bike lane is 1.5m(5 feet) from the face of a curb or guardrail to the bike lane stripe. This 1.5-m (5-foot) width should be sufficient in cases where a 0.3-0.6 m (1-2 foot) wide concrete gutter pan exists, given that a minimum of 0.9 m (3 feet) of ridable surface is provided, and the longitudinal joint between the gutter pan and pavement surface is smooth. The width of the gutter pan should not be included in the measurement of the ridable or usable surface, with the possible exception of those communities that use an extra wide, smoothly paved gutter

pan that is 1.2 m (4 feet) wide as a bike lane. If the joint is not smooth, 1.2m(4 feet) of ridable surface should be provided. Since bicyclists usually tend to ride a distance of 0.8-1.0 m (32-40 inches) from a curb face, it is very important that the pavement surface in this zone be smooth and free of structures. Drain inlets and utility covers that extend into this area may cause bicyclists to swerve, and have the effect of reducing the usable width of the lane. Where these structures exist, the bike lane width may need to be adjusted accordingly. Figure 6(4) depicts a bike lane on a roadway in an outlying area without curbs and gutters. This location is in an undeveloped area where infrequent parking is handled off the pavement. Bike lanes should be located within the limits of the paved shoulder at the outside edge. Bike lanes may have a minimum width of 1.2 m (4 feet), where the area beyond the paved shoulder can provide additional maneuvering width. A width of 1.5 m (5 feet) or greater is preferable and additional widths are desirable where substantial truck traffic is present, or where motor vehicle speeds exceed 80 km/h (50 mph). A bike lane should be delineated from the motor vehicle travel lanes with a 150-mm (6-inch) solid white line. Some jurisdictions have used a 200-mm (8-inch) line for added distinction. An additional 100-mm (4-inch) solid white line can be placed between the parking lane and the bike lane. This second line will encourage parking closer to the curb, providing added separation from motor vehicles, and where parking is light it can discourage motorists from using the bike lane as a through travel lane. Bike lanes should be provided with adequate drainage to prevent ponding, washouts, debris accumulation and other potentially hazardous situations for bicyclists. The drainage grates should be bicycle-safe. When an immediate replacement of an incompatible grate is not possible, a temporary correction of welding thin metal straps across the grates perpendicular to the drainage slots at 100-mm (4-inch) center-to-center spacing should be considered.

A smooth riding surface should be provided and utility covers should be adjusted flush with the surface. Raised pavement markings and raised barriers can cause steering difficulties for bicyclists and should not be used to delineate bicycle lanes.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

Shared Use Paths

Shared use paths are facilities on exclusive right-of-way and with minimal cross flow by motor vehicles. Shared use paths are sometimes referred to as trails; however, in many states the term trail means an unimproved recreational facility. Care should be taken in using these terms interchangeably. Where shared use paths are called trails, they should meet all design criteria for shared use paths to be designated as bicycle facilities. Users are non-motorized and may include but are not limited to: bicyclists, in-line skate rs, roller skaters, wheelchair users (both non-motorized and motorized) and pedestrians, including walkers, runners, people with baby strollers, people walking dogs, etc. These facilities are most commonly designed for two-way travel, and the guidance herein assumes a two-way facility is planned unless otherwise stated. Shared use paths can serve a variety of purposes. They can provide users with a shortcut through a residential neighborhood (e.g., a connection between two cul-de-sac streets). Located in a park, they can provide an enjoyable recreational opportunity. Shared use paths can be located along rivers, ocean fronts, canals, abandoned or active railroad and utility rights-of-way, limited access freeways, within college campuses or within and between parks. Shared use paths can also provide bicycle access to areas that are otherwise served only by limited access highways closed to bicycles. Appropriate locations can be identified during the planning process. Shared use paths should be thought of as a complementary system of off-road transportation routes for bicyclists and others that serves as a necessary extension to the roadway network. Shared use paths should not be used to preclude on-road bicycle facilities, but rather to supplement a system of on-road bike lanes, wide outside lanes, paved shoulders and bike routes. There are some similarities between the design criteria for shared use paths and highways (e.g., horizontal alignment, sight distance requirements, signing and markings). On the other hand, some criteria (e.g., horizontal and vertical clearance requirements, grades and pavement structure) are dictated by operating characteristics of bicycles that are substantially different from those of motor vehicles. The designer should always be aware of the similarities and differences between bicycles and motor vehicles and of how these similarities and differences influence the design of shared use paths. The remainder of this section provides guidance on each of the factors that should be considered in designing safe and functional shared use paths.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

Separation Between Shared Use Paths and Roadways

When two-way shared use paths are located immediately adjacent to a roadway, some operational problems are likely to occur. In some cases, paths along highways for short sections are permissible, given an appropriate level of separation between facilities. Some problems with paths located immediately adjacent to roadways are as follows:

1. Unless separated, they require one direction of bicycle traffic to ride against motor vehicle traffic, contrary to normal rules of the road.
2. When the path ends, bicyclists going against traffic will tend to continue to travel on the wrong side of the street. Likewise, bicyclists approaching a shared use path often travel on the wrong side of the street in getting to the path. Wrong-way travel by bicyclists is a major cause of bicycle/automobile crashes and should be discouraged at every opportunity.
3. At intersections, motorists entering or crossing the roadway often will not notice bicyclists approaching from their right, as they are not expecting contra-flow vehicles. Motorists turning to exit the roadway may likewise fail to notice the bicyclist. Even bicyclists coming from the left often go unnoticed, especially when sight distances are limited.
4. Signs posted for roadway users are backwards for contra-flow bike traffic; therefore these cyclists are unable to read the information without stopping and turning around.
5. When the available right-of-way is too narrow to accommodate all highway and shared use path features, it may be prudent to consider a reduction of the existing or proposed widths of the various highway (and bikeway) cross-sectional elements (i.e., lane and shoulder widths, etc.). However, any reduction to less than AASHTO Green Book 1 (or other applicable) design criteria must be supported by a documented engineering analysis.
6. Many bicyclists will use the roadway instead of the shared use path because they have found the roadway to be more convenient, better maintained, or safer. Bicyclists using the roadway may be harassed by some motorists who feel that in all cases bicyclists should be on the adjacent path.
7. Although the shared use path should be given the same priority through intersections as the parallel highway, motorists falsely expect bicyclists to stop or yield at all cross-streets and driveways. Efforts to require or encourage bicyclists to yield or stop at each cross-street and driveway are inappropriate and frequently ignored by bicyclists.
8. Stopped cross-street motor vehicle traffic or vehicles exiting side streets or driveways may block the path crossing.

9. Because of the proximity of motor vehicle traffic to opposing bicycle traffic, barriers are often necessary to keep motor vehicles out of shared use paths and bicyclists out of traffic lanes. These barriers can represent an obstruction to bicyclists and motorists, can complicate maintenance of the facility, and can cause other problems as well. For the above reasons, other types of bikeways are likely to be better suited to accommodate bicycle traffic along highway corridors, depending upon traffic conditions. Shared use paths should not be considered a substitute for street improvements even when the path is located adjacent to the highway, because many bicyclists will find it less convenient to ride on these paths compared with the streets, particularly for utility trips.

When two-way shared use paths are located adjacent to a roadway, wide separation between a shared use path and the adjacent highway is desirable to demonstrate to both the bicyclist and the motorist that the path functions as an independent facility for bicyclists and others. When this is not possible and the distance between the edge of the shoulder and the shared use path is less than 1.5m(5 feet), a suitable physical barrier is recommended. Such barriers serve both to prevent path users from making unwanted movements between the path and the highway shoulder and to reinforce the concept that the path is an independent facility. Where used, the barrier should be a minimum of 1.1 m (42 inches) high, to prevent bicyclists from toppling over it. A barrier between a shared use path and adjacent highway should not impair sight distance at intersections, and should be designed to not be a hazard to errant motorists.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

Width and Clearance

The paved width and the operating width required for a shared use path are primary design considerations. Under most conditions, a recommended paved width for a two-directional shared use path is 3.0 m (10 feet). In rare instances, a reduced width of 2.4m (8 feet) can be adequate. This reduced width should be used only where the following conditions prevail:

(1) bicycle traffic is expected to be low, even on peak days or during peak hours,
(2) pedestrian use of the facility is not expected to be more than occasional,
(3) there will be good horizontal and vertical alignment providing safe and frequent passing opportunities, and
(4) during normal maintenance activities the path will not be subjected to maintenance vehicle loading conditions that would cause pavement edge damage.

Under certain conditions it may be necessary or desirable to increase the width of a shared use path to 3.6 m (12 feet), or even 4.2 m (14 feet), due to substantial use by bicycles, joggers, skaters and pedestrians, use by large maintenance vehicles, and/or steep grades. The minimum width of a one-directional shared use path is 1.8 m (6 feet). It should be recognized, however, that one-way paths often will be used as two-way facilities unless effective measures are taken to assure one-way operation. Without such enforcement, it should be assumed that shared use paths will be used as two-way facilities by both pedestrians and bicyclists and designed accordingly. A minimum 0.6-m (2-foot) wide graded area with a maximum 1:6 slope should be maintained adjacent to both sides of the path; however, 0.9 m (3 feet) or more is desirable to provide clearance from trees, poles, walls, fences, guardrails or other lateral obstructions. Where the path is adjacent to canals, ditches or slopes down steeper than 1:3, a wider separation should be considered. A minimum 1.5 m (5-foot) separation from the edge of the path pavement to the top of the slope is desirable. Depending on the height of embankment and condition at the bottom, a physical barrier, such as dense shrubbery, railing or chain link fence, may need to be provided. The vertical clearance to obstructions should be a minimum of 2.5 m (8 feet). However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In undercrossings and tunnels, 3.0 m (10 feet) is desirable for adequate vertical shy distance.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

Undesirability of Sidewalks as Shared Use Paths

Utilizing or providing a sidewalk as a shared use path is unsatisfactory for a variety of reasons. Sidewalks are typically designed for pedestrian speeds and maneuverability and are not safe for higher speed bicycle use. Conflicts are common between pedestrians traveling at low speeds (exiting stores, parked cars, etc.) and bicyclists, as are conflicts with fixed objects (e.g., parking meters, utility poles, sign posts, bus benches, trees, fire hydrants, mail boxes, etc.) Walkers, joggers, skateboarders and roller skaters can, and often do, change their speed and direction almost instantaneously, leaving bicyclists insufficient reaction time to avoid collisions. Similarly, pedestrians often have difficulty predicting the direction an oncoming bicyclist will take. At intersections, motorists are often not looking for bicyclists (who are traveling at higher speeds than pedestrians) entering the crosswalk area, particularly when motorists are making a turn. Sight distance is often impaired by buildings, walls, property fences and shrubs along sidewalks, especially at driveways. In addition, bicyclists and pedestrians often prefer to ride or walk side-by-side when traveling in pairs. Sidewalks are typically too narrow to enable this to occur without serious conflicts between users. It is especially inappropriate to sign a sidewalk as a shared use path or designated bike route if to do so would prohibit bicyclists from using an alternate facility that might better serve their needs. It is important to recognize that the development of extremely wide sidewalks does not necessarily add to the safety of sidewalk bicycle travel. Wide sidewalks might encourage higher speed bicycle use and can increase potential for conflicts with motor vehicles at intersections, as well as with pedestrians and fixed objects. For guidance on when and how to designate sidewalks as signed bikeways.

Bicycles at Modern Roundabouts

Generally there are three ways to accommodate bicyclists in roundabouts:
1) in mixed flow with vehicular traffic,
2) along separate bicycle paths, and
3) on bicycle lanes along the outside diameter of roundabouts (not currently recommended).

The following safety issues should be considered when contemplating bicycles in roundabouts:

- Bicyclists are vulnerable users of roundabouts and consideration should be given for their accommodation.
- In low-speed [approximately 20 km/hr (12 mph)], single-lane roundabouts, few negative safety impacts have been observed when bicycles are mixed in the traffic stream. Because of the small speed differential, bicyclists are expected to circulate in the

traffic lane at approximately the same speed as vehicles. When bike lanes lead to this type of roundabout, it is preferable to discontinue them 10 to 20 m (35 to 65 feet) before reaching the roundabout, rather than continuing the lane through the roundabout.

- Bicycle safety tends to deteriorate at higher speed, multi-lane roundabouts and at flared entries. At these roundabouts, special solutions should be sought when warranted by bicycle volumes. Among the possible solutions are separate bikeways, shared use of the pedestrian facility, separate bike routing through other intersections, or grade separation for the vulnerable modes. A majority of bike crashes at roundabouts involve entering vehicles and circulating bicycles, reinforcing the need to reduce entering speeds by providing ample deflection, to maintain good visibility for entering traffic and to enforce yield conditions for entering traffic.

Obstruction Markings

Vertical barriers and obstructions, such as abutments, piers and other features causing bikeway constriction, should be clearly marked to gain the attention of approaching bicyclists. This treatment should be used only where the obstruction is unavoidable, and is by no means a substitute for good bikeway design. An example of an obstruction marking is shown in Figure 30. Signs, reflectors, diagonal yellow markings or other treatments may be appropriate to alert bicyclists to potential obstructions.

Additional Bicycle Amenities

There are several other improvements that complement bicycle facilities. For example, turnouts or rest areas may be provided on long, uninterrupted shared use paths. Provisions should be considered for interfacing bicycle travel with public transit, such as racks on buses, buses converted to carry bicycles aboard, or allowing bicycles on ferries and rapid rail facilities.

Printing and distributing bikeway maps is a high-benefit, low-cost project that is easily accomplished. Maps can help bicyclists locate bikeways and parking facilities and identify the relative suitability of different segments of the road system. Also, maps can help bicyclists avoid narrow, high-speed, or high-volume roads, one-way streets, barriers and other problems. In addition, maps can provide information on Rules of the Road, bicycle safety tips and interfacing with mass transit.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

Accessibility Requirements

The Americans with Disabilities Act (ADA) of 1990 is civil rights legislation that prohibits discrimination against people with disabilities. It guarantees the right to participate fully and equally in all aspects of life. Accessibility to transportation systems means providing usable facilities for the highest number of people possible. Accessible features can benefit almost everyone. What is helpful for a wheelchair user, e.g., curb ramps, will also benefit bicyclists. Low grades and cross slopes not only make a facility usable for people with mobility impairments, but can also improve a transportation circulation system for all pedestrians, bicyclists and inline skaters. There are 48.9 million Americans with disabilities; 70 percent of all Americans will at some time in their lives have a temporary or permanent disability that makes such activities as stair climbing impossible. People may have mobility, visual and cognitive disabilities that affect how usable a facility may be for them. As our population grows older, the percentages of people with disabilities will increase. What we build today will be with us for many years. These designs need to accommodate as many users as possible. When choosing bicycling or walking as a transportation mode, users often want a convenient, direct route that will not exhaust their energy in getting to their destination. This can be especially true for people with disabilities. Saving energy often is the reason a person chooses driving over cycling and walking. Designers of shared use paths need to keep in mind that well-designed accessible facilities are usually more functional for all users, with and without disabilities. Federal ADA standards have been developed for buildings and their sites, but not for outdoor developed areas. Some states and localities have developed their own standards for outdoor accessibility that must be followed. Federal standards for this development, which would include shared use paths, are in the process of being drafted by a Committee of Federal agencies and interested organizations. It is understood that constructing facilities in the outdoors may have certain limitations that may make it difficult to build fully accessible paths. The conditions that would prevent full accessibility include those that:

- Cause harm to significant natural, cultural, historic or religious characteristics of a site
- Alter the fundamental experience of the setting or intended purpose of the trail
- Require construction methods that are prohibited by federal, state or local regulations
- Involve terrain characteristics (e.g., slope, soils, geologic or aquatic) that prevent compliance with the technical provision

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

Many of the provisions being developed by the Regulatory Negotiation Committee on Outdoor Developed Areas, such as surface treatment, minimum path width, changes in the level surface, and passing space, will automatically be met in the construction of a path suitable for bicycle travel. Once these provisions are adopted, they should be consulted when designing bicycle facilities. What if an existing path is not accessible? Do as much as possible to remove the barriers. Good signing at the trail access points that identify situations that could be difficult to traverse (such as steep grade and cross slope, narrow width and uneven surface conditions) will help users determine for themselves whether to use the path.

Rational for Accessible Design

Understanding how people with various disabilities function in the outdoor transportation environment is the first step in trying to accommodate their design needs. Wheelchair Users—Low running grades, preferably below 5 percent, are desirable because exertion is needed to push up, and controlling the wheelchair going down on steep grades is a problem. Cross slopes should be no more than 2-3 percent. The greater the cross slope the greater the gravity pull on the wheelchair to turn into the slope. Combining a steep running grade with a steep cross slope increases the difficulty of maneuvering a wheelchair. On a hardened or paved surface, a 2 percent cross slope will drain off water in most cases. Amenities, such as phones, water fountains and pedestrian-actuated signal controls, need to be placed no higher than 2.4 m (4 feet) from the ground level. Wheelchair users have a lower reach range and a lower sight perspective of the environment. The buttons on actuated signals need to be large, protruding and easy to push for those who have limited mobility in their hands. The buttons also need to be placed in an accessible path of travel for a wheelchair user. Visually Impaired—Most sighted people get their directional and spatial cues visually. People who are totally blind get their cues from sound and touch. People with low vision (78 percent of the legally blind population) may have an additional advantage of detecting contrasting colors. Older people often lose their hearing and vision at the same time, creating a compound difficulty. Older individuals, who lose their vision gradually, may not be trained in wayfinding techniques. Cars are getting quieter, curb radii wider, and street crossings longer. All these factors contribute to a hostile pedestrian environment, especially for the visually impaired.

Curb ramps are typically thought of as an accommodation for bicyclists and wheelchair users, but they can be used by the visually impaired as a warning of the transition from the path to the street. If they fail to detect the ramp, they are at risk of walking into the street, which may result in serious consequences. If the ramp grade is low, a visually

impaired person may not detect the transition. Detectable warnings and contrasting colors at the bottom of ramps may help detect the presence of a curb ramp. A tradeoff may exist between the visually impaired and mobility impaired when using truncated domed surfaces, because maneuverability may be more difficult for both the bicyclist and the mobility impaired. People with Limited Cognitive Abilities—We are learning that children under the age of 12 do not often think about the rules of the road (path), even when they have been taught. Their ability to take in and perceive the road environment, and then perform the multiple tasks needed to make fast decisions, may not be developed. Planners and designers need to take into account the mixing of faster moving modes with pedestrians when determining facility design, especially if the path is a school route. Adults with cognitive disabilities may benefit from easy-to-interpret signs. This may be particularly important when a path intersects with another path or street.

Operation and Maintenance

The jurisdictions responsible for the operation, maintenance and policing of bicycle facilities should be established prior to construction. In addition to construction costs, operating and maintenance costs should be considered and included in the overall budget for the facility. Neglecting routine maintenance eventually may render bicycle facilities unridable and such deteriorating facilities may become a liability to the state or community. Bicyclists should be encouraged to report bicycle facilities that are in need of maintenance. A central contact person who can authorize maintenance work should be designated to receive such reports.

A smooth surface, free of potholes and debris, should be provided on all bikeways. Glass, sand, litter and fallen leaves often accumulate on bike lanes, paved shoulders and shared use paths; therefore, regular sweeping is desirable. Pavement edges should be uniform and should not have abrupt drop-offs. Signs and pavement markings should be inspected regularly and kept in good condition, and if determined to be no longer necessary, promptly removed. Highways with bicycle traffic may require a more frequent and higher level of maintenance than other highways. For shared use paths, attention should be given to maintaining the full paved width and not allowing the edges to ravel. Trees, shrubs and other vegetation should be controlled to provide adequate clearances and sight distances. Trash receptacles should be placed and maintained at convenient locations. Seeded and sodded areas in the vicinity of shared use paths should be mowed regularly. Snow plowing should be used to remove snow from bikeways because de-icing agents and abrasives can damage bicycles. Also, enforcement is often necessary to prevent unauthorized motor vehicles from using a shared use path.

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

The routine maintenance of roadways and bikeways will usually provide good riding conditions. Several bicycle facility improvements described in this guide can be implemented during routine maintenance activities. Consideration also can be given to adjusting lane widths and providing wider outside curb lanes for bicyclists during restriping operations. The addition of edge lines can better delineate a shoulder, especially at night. When shoulders are resurfaced, a smooth surface suitable for bicycle riding should be considered.

HARWICH TRAFFIC SAFETY COMMITTEE
HARWICH BIKEWAYS COMMITTEE
HARWICH DISABILITIES RIGHTS COMMITTEE

draft 12/18/10

TRANSPORTATION FACILITIES for BICYCLES and PEDESTRIANS

RESOURCES

Cape Cod 2011 Regional Transportation Plan (draft)
http://www.gocapecod.org/rtp/

Cape Cod 2011 Regional Transportation Plan (draft) -Chapter 5
http://www.gocapecod.org/rtp/RTP2011docs/05_BikePlan-RTP2011-10042010.pdf

American Association of State Highway and Transportation Officials
Guide for the Development of Bicycle Facilities
http://www.sccrtc.org/bikes/AASHTO_1999_BikeBook.pdf

MassDOT Bicycle & Pedestrian Accommodation Policy
http://www.eot.state.ma.us/acceleratedbridges/downloads/engineers_presentation_033010.pdf

Massachusetts Highway Department Project Development & Design Guide.
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http://www.vhb.com/mhdGuide/mhd_Guidebook.asp

Massachusetts Highway Department Project Development & Design Guide.
Chapter 3 -Basic Design Controls
http://www.vhb.com/mhdGuide/pdf/CH_3_a.pdf

Massachusetts Highway Department Project Development & Design Guide.
Chapter 5 -Cross Section and Roadside Elements
http://www.vhb.com/mhdGuide/pdf/CH_5_a.pdf

Massachusetts Highway Department Project Development & Design Guide.
Chapter 11 -Shared Use Paths and Greenways
http://www.vhb.com/mhdGuide/pdf/CH_11_a.pdf

MassHighway Policy Directive P-98-003;
Bicycle Route and Share the Road Signing Policy
http://www.mhd.state.ma.us/downloads/engineeringDirectives/policy/p_98_003.pdf

Federal Highway Administration
Selecting Roadway Design Treatment to Accommodate Bicycles
http://katana.hsrc.unc.edu/cms/downloads/Selecting_Treatments_Bikes1992.pdf
Selecting Roadway Design Treatment to Accommodate Bicycles -Tables
http://safety.fhwa.dot.gov/ped_bike/docs/tables.pdf