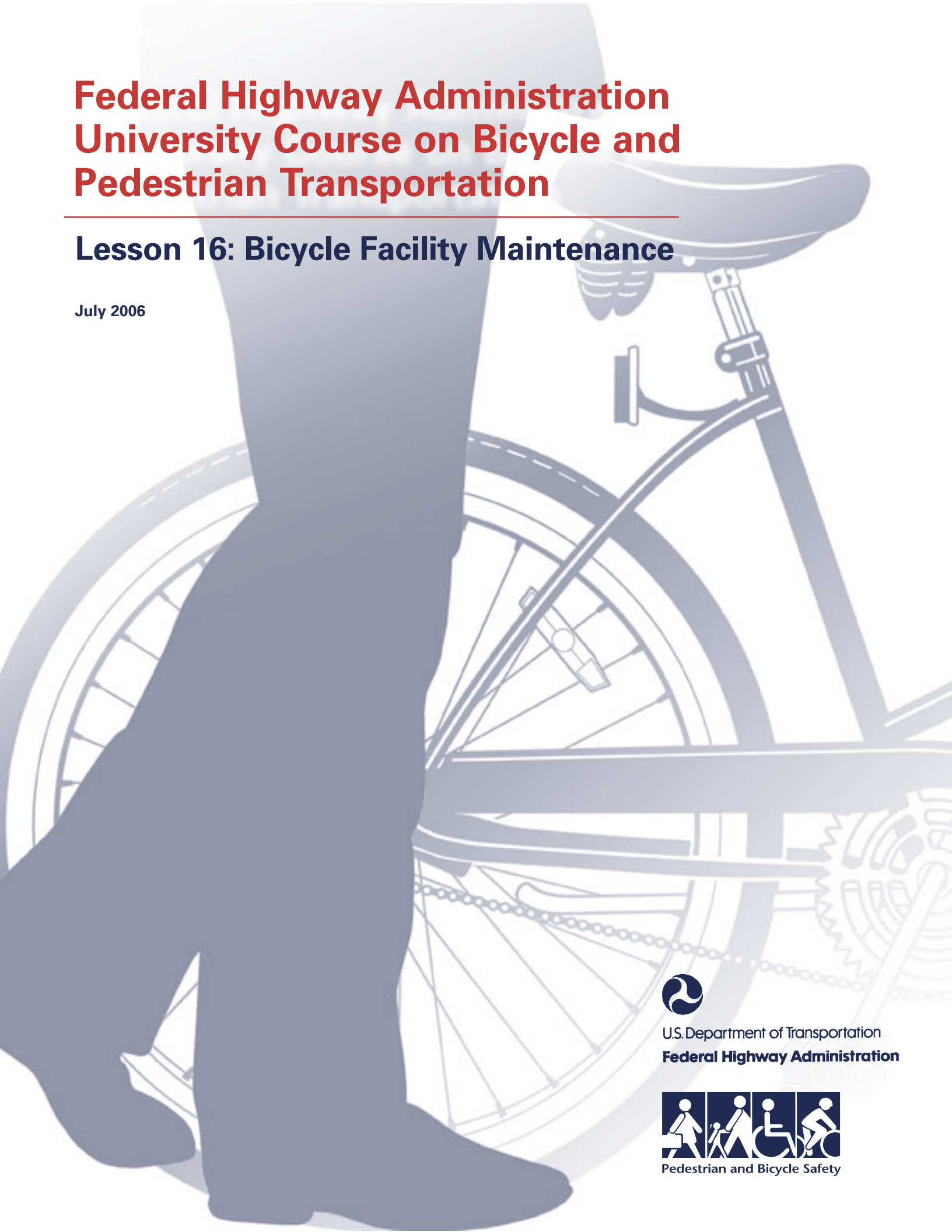
Federal Highway Administration University Course on Bicycle and Pedestrian Transportation

Lesson 16: Bicycle Facility Maintenance

July 2006



U.S. Department of Transportation
Federal Highway Administration

Pedestrian and Bicycle Safety

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LESSON 16:

BICYCLE FACILITY MAINTENANCE

16.1 Introduction

This lesson describes maintenance programs and activities that are critical to successful bicycle facilities, and it recommends a step-by-step approach to solving common maintenance problems. The major sections of this lesson are as follows:

- 16.1 Introduction.
- 16.2 Problem Overview.
- 16.3 Solution Overview.
- 16.4 Objectives.
- 16.5 Implementation Strategies.
- 16.6 Subtasks.
- 16.7 Schedule and Resource Requirements.
- 16.8 Typical Maintenance Concerns.
- 16.9 Student Exercise.
- 16.10 References and Additional Resources.

This lesson on bicycle facility maintenance has been primarily derived from the "Bicycle-Related Maintenance" chapter of the Federal Highway Administration (FHWA) publication, *Implementing Bicycle Improvements at the Local Level*.[1] Other sources of information are listed at the end of the lesson.

16.2 Problem Overview

Bicycles and bicyclists tend to be particularly sensitive to maintenance problems. Many bicycles lack suspension systems, and as a result, potholes that motorists would hardly notice can cause serious problems for bicyclists. In addition, since bicyclists often ride near the right edge of the road—sometimes as required by traffic law—they use areas that are generally less well maintained than the main traffic lanes. On roads with higher vehicle speeds, air from passing vehicle traffic typically sweeps debris to the right where most bicyclists travel. In addition, ridges, such as those found where a new asphalt overlay does not quite cover the older roadway surface, can catch a wheel, and throw a bicyclist to the ground.

Aside from these general problems, special bicycle facilities often need more maintenance than they receive. On shared-use trails, for example, vegetation is often allowed to overgrow the pavement edge, effectively narrowing the usable surface. Soil treatments that are commonly used under new roadbeds are sometimes ignored on trail projects; as a result, the surfaces are quickly destroyed by intruding plants.

16.3 Solution Overview

For the most part, satisfying bicycle facility maintenance requirements is a matter of slightly modifying current roadway procedures. For example, if street sweeping crews pay a bit more attention to the right edge of the road, it can benefit bicyclists greatly.

In addition, using maintenance-friendly design and construction techniques can reduce the need for special and sometimes costly treatments later. For example, when paving a street bordered by unpaved alleys and driveways, paving into those alleys and driveways 3 to 6 meters (m) (10 to 20 feet (ft)) (depending on grades and other features) can keep entering traffic from dragging gravel and other debris onto the paved surface.

Special bicycle facilities such as bike lanes or trails may require enhanced maintenance (see figure 16-1). This cost, along with a clear understanding of who has responsibility for maintenance, should be part of every project budget.

Figure 16-1. Photo. Shared-use paths and bicycle lanes may require additional maintenance.

16.4 Objectives

The primary objectives of a bicycle facility maintenance program should be to:

1. Maintain roadways and bikeways to a relatively hazard-free standard. This can be accomplished by:

Sweeping pavement edges and paved shoulders with sufficient care.
Patching surfaces as smoothly as possible and requiring other agencies or private companies to do likewise whenever they dig up a road or trail.
Making sure pavement overlay projects feather the new surface into the existing one or otherwise do not create new linear joints.
Replacing such hazards as dangerous grates or utility covers as the opportunity arises.
Patching potholes in an expeditious manner.
Routinely cutting back all encroaching vegetation, especially on trails or popular bike routes.

2. Encourage bicyclists to report maintenance problems and hazards. This can be accomplished by:

Developing a bicycle spot improvement form and distributing copies throughout the bicycling community.
Making sure returned forms are acted on in a timely fashion.

3. Design and build new roadways and bikeways in such a way as to reduce the potential for accumulating debris. This can be accomplished by:

Using edge treatments, shoulder surfaces, and access controls that reduce the potential for accumulation of debris (see figure 16-2).
Using materials and construction techniques that increase the longevity of new trail surfaces.

Figure 16-2. Photo. Roadways with paved shoulders should reduce on-road debris.

4. Include maintenance costs and clearly spelled-out maintenance procedures in all bicycle facility projects. This can be accomplished by:

Including reasonable estimates of the maintenance costs in the project budget.
Establishing clear maintenance responsibilities in advance of construction.

16.5 Implementation Strategies

Improving maintenance for bicycle facilities requires action on several fronts. First, maintenance policies used by all relevant agencies should be reviewed and changed, if necessary. Second, designers should be encouraged to think maintenance when they design: low-maintenance requirements should be the rule rather than the exception. And, finally, an outreach effort should be implemented to:

Encourage bicyclists to report maintenance problems.
Identify existing maintenance problems, particularly on special bicycle facilities or popular bicycling routes.

16.6 Subtasks

Subtask 1—Identify Key Implementers

Implementation requires working closely with those agencies and personnel responsible for maintaining the current infrastructure, as well as those charged with designing and building new facilities. For roadway maintenance, this may mean the local street department or the State transportation agency's district maintenance division. For trails, it may mean local, State, or Federal parks or lands agencies.

New facility design can involve local engineering and parks planning agencies, as well as State and Federal officials, depending on jurisdiction. It may be, for example, that a new arterial street being built in the local community is actually designed by engineers working in a remote headquarters office.

Subtask 2—Review Existing Policies and Practices

In some cases, an agency's policies, standards, and guidance are included in formal documents that have gone through an approval process or that have been issued by department supervisors. Examples of these may be standard sweeping schedules and priority streets for snow removal. Conducting a review of these may be relatively simple once copies have been obtained.

On the other hand, some practices may simply be matters of how a particular person handles a specific task. For instance, one street sweeper may leave more of the right roadway edge unswept than did another sweeper. Identifying important areas in which practices vary from standard procedure—or in which standard procedures do not exist—can help in determining needed improvements in such areas as policy development, communication, and employee training.

Subtask 3—Review Results in the Field and Solicit Comments from Users

In some cases, policies may seem reasonable in theory but may break down in practice. For this reason, it is important to see how well the facilities work. Checking out the street and trail system from the saddle of a bicycle can help uncover previously unknown problems. For instance, an agency may have a policy of sweeping arterial streets every two weeks. But field experience may show that certain arterials are subject to greater accumulations of debris from nearby land uses. Increasing the frequency of sweeping on such streets—particularly if they are popular bicycling streets—may be necessary.

In addition, soliciting comments from users can help identify problems that would otherwise be overlooked. Because of their intimate knowledge of surface conditions, bicycle users can often pinpoint specific locations and needs. To get information, send news releases to local bicycle groups, as well as the media, asking for help. In all likelihood, users will welcome the opportunity to contribute.

Subtask 4—Recommend Appropriate Changes in Policies and Practices

Based on the reviews and comments discussed above, develop modified versions of policies and practices where warranted; for important topics not previously covered, develop new guidance for adoption. Work with the appropriate agencies to make sure the changes are understood and implemented.

Subtask 5—Create an Ongoing Spot Improvement Program

As mentioned earlier, soliciting comments from users can help an agency find specific problem locations. Institutionalizing this process, in the form of a spot improvement program, can provide ongoing input and, in many cases, help identify problems before someone gets hurt. In addition, such a program can dramatically improve the relationship between an agency and the bicycling public. Spot improvement programs are good policy and good public relations.

To this end, set aside a modest annual budgetary allocation for user-requested spot improvements. Create mail-back postcards (see figure 16-3 for example postcard) for distribution to local bicycle shops and user groups. As cards come in, check out the locations identified and take action as necessary.

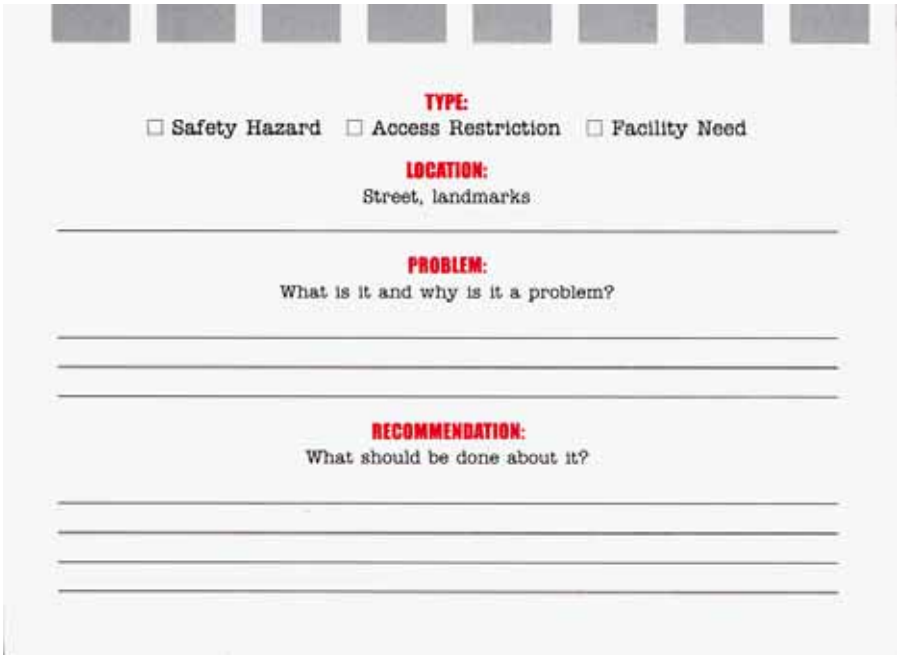

Figure 16-3. Photo. Example of spot improvement postcard used to identify roadway maintenance issues.
Source: Vermont Bicycle & Pedestrian Coalition[2]

Subtask 6—Evaluate Progress

As the work proceeds, keep track of successes and failures, as well as the schedule of routine maintenance activities. Identify changes that have or have not been made to policies and determine if additional effort is needed. On an annual basis, ask the bicycling public for comments on maintenance issues in general, and the spot improvement program in particular. In addition, keep track of the numbers and kinds of problems identified and how they were dealt with. Finally, determine if the program budget is appropriate to the task.

16.7 Schedule and Resource Requirements

In regions with harsh winters, special effort should be made to clear the winter's accumulation of road sand and other debris early in the spring. Also, the periods following high winds and flooding may require special attention.

For the most part, bicycle-related maintenance tasks involve the work an agency already does; little additional effort will be required. It may simply mean adding popular bicycling routes to the priority sweeping route network, for example. In some instances, however, additional equipment may be needed. For example, maintaining a particular trail may require purchasing special equipment—perhaps a small sweeper or a special attachment for a tractor.

16.8 Typical Maintenance Concerns

The following paragraphs list and describe bicyclists' most common maintenance concerns and some typical solutions.

Surface Problems

Potholes and other surface irregularities. Patch to a high standard, paying particular attention to problems near bicyclists' typical travel alignments. Require other agencies and companies to patch to a similarly high standard; if repairs fail within a year, require remedial action.

Debris (sand, gravel, glass, auto parts, etc.) near the right edge of the road. Sweep close to the right edge. If necessary, use vacuum trucks to remove material, especially if it accumulates adjacent to curbs. Pay particular attention to locations such as underpasses, where changes in lighting conditions can blind bicyclists to surface hazards.

Debris or surface irregularities on curves or at intersections. Pay special attention to the areas between the typical paths of turning and through motor vehicle traffic; often these fill with debris and are in typical bicyclist trajectories. In addition, areas where debris washes across the paved surface should receive special attention; for example, eliminating the source of the problem by providing better drainage is ultimately a more cost-effective solution than increased sweeping.

Chip seal gravel. Many local agencies use chip seal to extend the lives of their roadways. However, the technique, which involves laying down a coating of oil and a layer of crushed rock, often leaves deep piles of gravel just to the right of the typical travel paths of motor vehicles. To reduce the impact on bicyclists, remove excess gravel as soon as possible and suggest alternative routes as detours.

Ridges or cracks. These should be filled or ground down as needed to reduce the chance of a bicyclist catching a front wheel and crashing. Pay particular attention to ridges or cracks that run parallel to the direction of travel. One common location to check is where a merging lane is provided just beyond an intersection. Because traffic must merge left to continue traveling straight, the bicyclist will be crossing the joint between the merge lane and the through lane at a very shallow angle.

Snow removal. Many shared use paths in colder climates will require snow removal during the winter. Snowplows and other snow removal equipment typically used for streets are often much too large to maneuver on shared-use paths. Special snow removal equipment and policies should be considered part of regular trail maintenance. Snow removal policies for shared-use paths should address the overall priority of this activity and estimated clearance times so that trail users can adjust their trips and expectations accordingly. In some cases, snow removal policies may also address whether snow is to be cleared. Along some trails and paths in northern climates, snow is left in place for the benefit of cross country skiing and other snow-related activities.

Encroaching Vegetation

Bushes and tree branches adjacent to trail edges. Trim vegetation back to allow at least a 0.6-m (2-ft) clearance between the edge of the pavement and the vegetation, paying particular attention to the insides of curves.

Grasses adjacent to trail edges. Tall grasses should be mowed regularly to expose any potential hazards that might otherwise be hidden from a cyclist's view. In addition, vegetation should be prevented from breaking up the edge of pavement and encroaching on the trail surface.

Signing and Marking

Trail signing. Because they are often unique, trail signs may be subjected to frequent theft or vandalism. Regular inspections should be conducted to ensure that signs are still in place and in good condition; this is particularly true of regulatory and warning signs.

Trail markings. Generally, trails have a few simple markings (e.g., a yellow center line); however, these should be repainted when necessary (see figure 16-4). Center lines, for example, perform the very useful function of encouraging bicyclists to keep to their side of the trail.

On-road bicycle signs. Special bicycle signs (regulatory, warning, or information) should be maintained in the same way that other roadway signs are. Pay particular attention to bike route signs at decision points, warning signs at special hazard locations, and regulatory signs on popular streets with bike lanes.

On-road bicycle markings. Bicycle lane striping should be renewed at the same time that other stripes are painted. The same goes for bike lane pavement markings. Some markings may suffer from more wear-and-tear than others and deserve special attention. For instance, pavement markings that indicate the hot spot for traffic signal loop detectors may be in a location where car tires routinely pass; as a result, they may wear out faster than other markings.

Figure 16-4. Photo. Example of newly striped bicycle lane with accumulation of debris next to curb.
Source: Pedestrian and Bicycle Information Center (PBIC) Image Library, http://www.pedbikeimages.org[3]

16.9 Student Exercise

Inventory three to five bicycle facilities, rating their condition based on the techniques learned in the lesson (surface, vegetation, etc.—what are the problems and potential solutions?). Review policies and procedures to make improvements to the bicycle facility, documenting the ease of reporting and the remedy of any deficiencies reported.

16.10 References and Additional Resources

The references for this lesson are:

Williams, J., B. Burgess, and B. Wilkinson, *Implementing Bicycle Improvements at the Local Level*, U.S. Department of Transportation, Federal Highway Administration, Publication No. FHWA-RD-98-105, Washington, DC, September 1998.

1. Vermont Bicycle & Pedestrian Coalition, available online at http://www.vtbikeped.org, accessed May 17, 2004.
2. Image Library, Pedestrian and Bicycle Information Center (PBIC), available online at http://www.pedbikeimages.org, accessed May 6, 2004.

Additional resources for this lesson include:

- AASHTO Maintenance Manual: The Maintenance and Management of Roadways and Bridges, 3rd Edition, American Association of State Highway and Transportation Officials, Washington, DC, 1999.
- Flink, C.A., K. Olka, and R.M. Searns, Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails, Island Press, Washington, DC, 2000.
- *Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials (AASHTO), Washington, DC, 1999.

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