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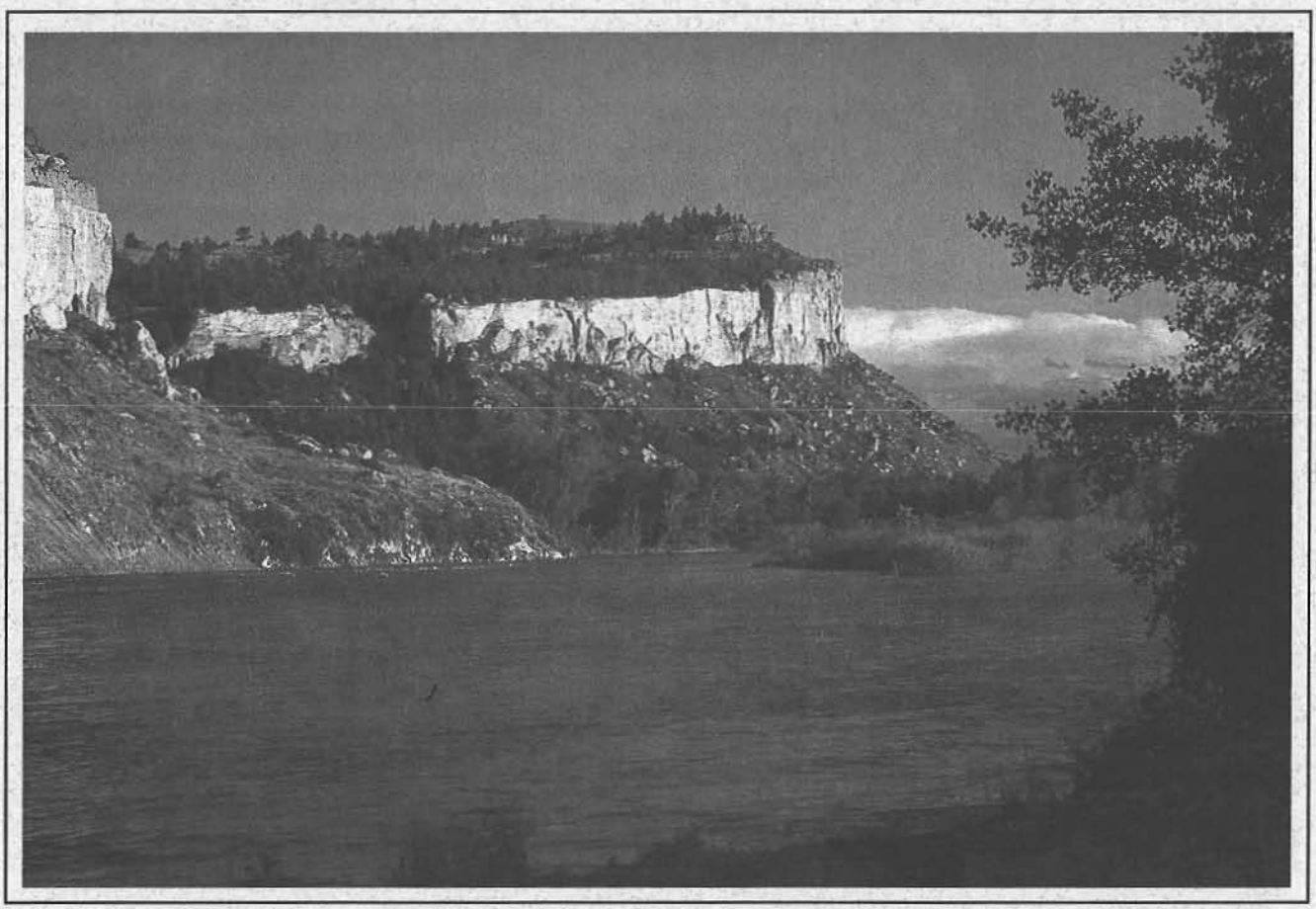
BikeNet
BILLINGS • YELLOWSTONE COUNTY

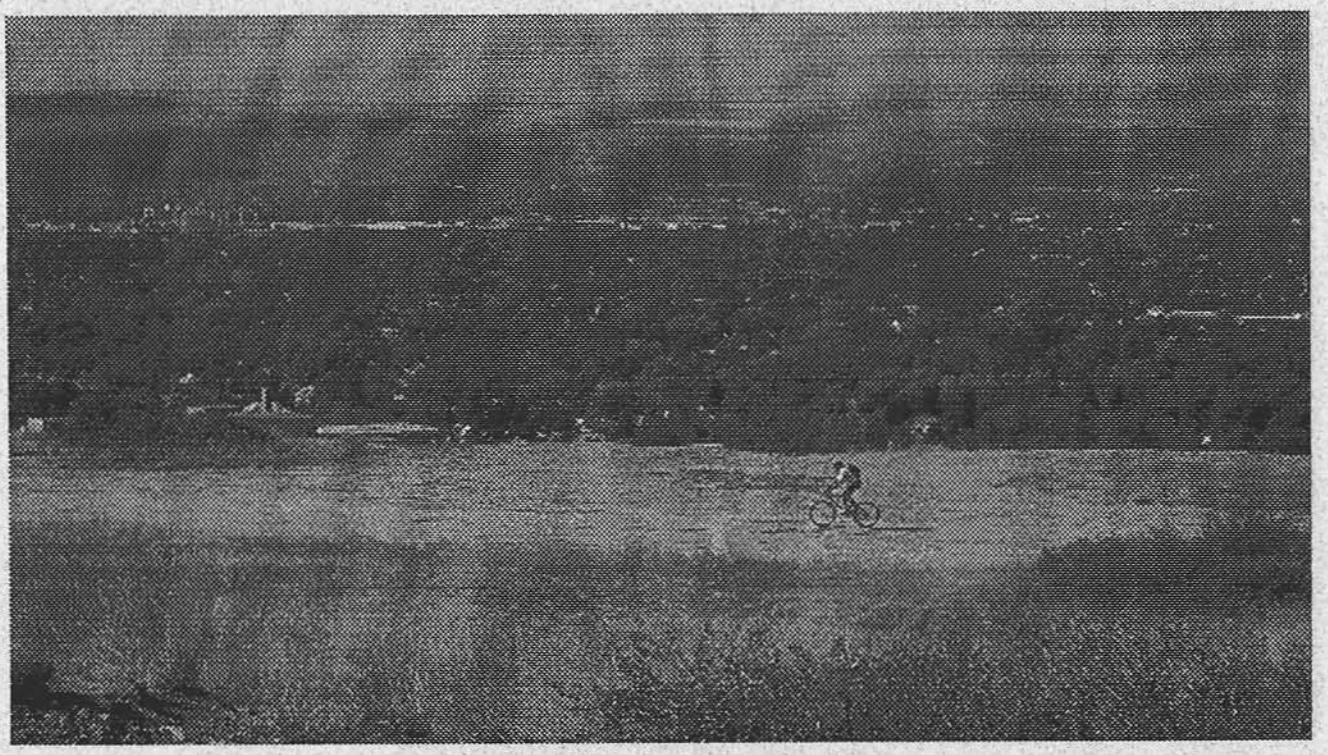
TRANSPORTATION - RECREATION - ACCESS - CONSERVATION

Bicycle Plan For The Billings Urban Transportation Planning Area



Prepared For
Yellowstone County Planning
December 15, 1994

Prepared By
Fischer & Associates
Billings, Montana



A Biker Makes His Way Along The Rims Above Billings

FISCHER & ASSOCIATES
Landscape Architecture - Land Planning

2815 Montana Avenue
Billings, Montana 59101

PLAN ADOPTED

Yellowstone County Planning Board
January 10, 1995

Billings City Council
January 23, 1995

Yellowstone County Commissioners
January 26, 1995

Transportation Policy Coordinating Committee
January 31, 1995

LEADERSHIP

BikeNet Advisory Committee

Bill Armold	Director, Yellowstone County Planning
Cal Cumin	Consultant to Yellowstone Co. Parks & YRPA
Paul Du Charme	Yellowstone Chair, County Planning Board
Mike Hink	Director City Parks, Cemeteries and Public Lands
Glen Hladek	Yellowstone County Safety Task Force & YVCC
Kevin Justis	City Councilman
Terry Smith	City Traffic Engineer
Scott Walker	Yellowstone County Transportation Planner
Ziggy Ziegler	County Commissioner

City Council

Mr. Jeff Regnier	City Council, Ward I
Ms. Lynn Davis Rightmire	City Council, Ward I
Mr. Dan Farmer	City Council, Ward II
Mr. Kevin Justis	City Council, Ward II
Mr. John Michunovich	City Council, Ward III
Mr. Mark Kennedy	City Council, Ward III
Mr. Owen Nieter	City Council, Ward IV
Mr. Ralph Stone	City Council, Ward IV
Mr. Mark Elison	City Council, Ward V
Mr. Normond Kolpin	City Council, Ward V

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Mr. Mike Mathew
Mr. Ziggy Ziegler

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Mr. Douglas Clark
Mr. Chuck Hensley
Ms. Patricia Jaffray
Mr. Ed Kammerer
Mr. Robert Lenhardt
Ms. Shirley McDermott
Mr. James Ruff
Mr. Michael Young

Special Thanks to:

The BikeNet Advisory Committee
Community Citizens who gave their time for this project
Mr. Ken Haag, Director of Public Works for workshop participation
Ms. Jane Kingsbury and Mr. Ron Wenger of MET Transit for planning participation
Yellowstone Valley Cyclists- donations of cash and time
An Anonymous Donor for financial assistance for public involvement facilitation
Deaconess Medical Center and the YMCA for donations of space
The Billings Gazette for assistance with public information dissemination
Earl Guss and The Yellowstone River Parks Association for assistance and support
Larry Fischer and Phil Bell of High Plains Productions, Inc. for donations of photography

Consultants

Prime Consultant: Fischer & Associates
Sandra Fischer, David Groshens, Jessica Kramer, Faye Turley
Pubic Involvement Consulting: Sara Jane Maclennan, ASLA
Recreation Planning & Design: Gary Lacy, P.E.
Engineering Inc. John Stewart P.E.
High Plains Productions, Photography & Graphic Design, Larry Fischer, Phil Bell,
Wenk & Associates: Bill Wenk, ASLA
Transportation Consultant: David Mozer

Participating Organizations

Citizens of Billings and
Yellowstone County
Beartooth Bicycle & Sports
Bike Shop
BBWA : Billings Bench Water Association
Billings Gazette
BLM Land Resources/Recreation
Bureau of Reclamation
Chamber of Commerce
Billings City Council
City of Billing Police Department
City of Billings Administration
City Departments of
Parks
Public Works
Public Utilities
Community 7 TV
Yellowstone County Commission
Deaconess Medical Center
Department of Fish Wildlife and Parks
Dept. of Nat. Resources
Downtown Billings Association
Eastern Montana College
First Interstate Bank
High Ditch (Chairman)
Kiwanis and Optimists Clubs
KULR 8
Lake Elmo Development Committee.
MET Transit
Metra Park
Montana TradePort
Montana Department of Transportation
Montana Tour Group
North Park Task Force
Offices of
Senator Baucus and Burns
Representative Williams
Parks/Recreation /Cemetery Board
Planning Board
Rimrock Stages/Mt Highway Commission
Scenic America
Scheels Sport Shop
Southside Task Force
Spoke Shop
St.Vincent Hospital & Health Center.
The Cyclery
Western Heritage Center
Yellowstone Co. Surveyor's Office
Yellowstone Co. Attorney
Yellowstone County Parks Board
Yellowstone County Sheriff's Department
Yellowstone County Traffic Safety Task
Force
Yellowstone River Parks Association
Yellowstone Valley Cycling Club
Zoo Montana

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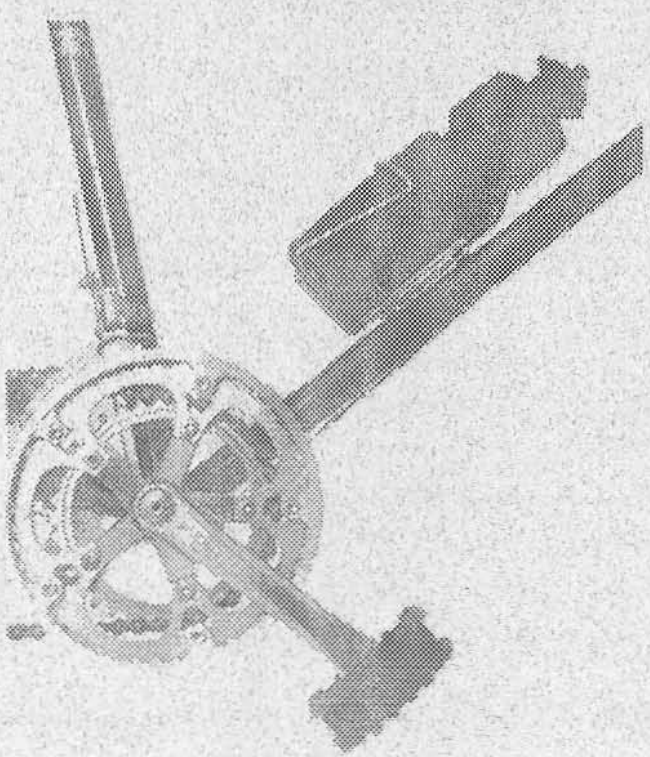
I. OVERVIEW

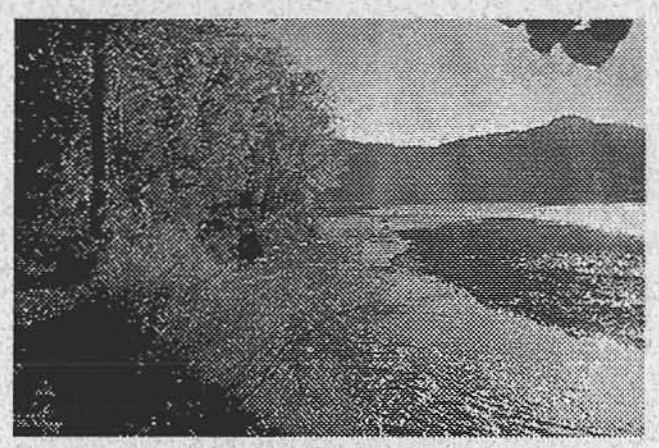


What Is BikeNet?

BikeNet, is a vision for improving our quality of life by making the Billings community an inviting place for bicycles and pedestrians. The vision includes transportation options, recreation enhancements, improved access to resources by all populations and conservation of community resources. Plan recommendations address land use, transportation and bicycle policy, encouragement, education, enforcement programs and bicycle facility improvements.

The adopted plan will be an amendment to the Billings Urban Transportation Plan. Taking direction from the *1990 Yellowstone County Comprehensive Plan, The1990 Billings Transportation Plan* and the citizens, the plan describes the future bicycling system and recommends actions to make the plan a reality.

The Community of Billings



View of Yellowstone River from Riverfront Park

Why Is A Plan Needed?

Public interest and support for bicycle facilities is growing nationwide. The support is most evident locally in the numerous recent Community Transportation Enhancement Program (CTEP) applications for bike paths as well as activities of the Yellowstone River Parks Association (YRPA). Strong community support for development of bicycle facilities is also documented in the recent *Community Needs Assessment* conducted by the United Way. The 1991 Federal Transportation Bill, Intermodal Surface Transportation Efficiency Act (ISTEA) recognizes bicycling as a legitimate form of transportation and encourages increased use of bicycles for short commuting trips. Planning provisions in ISTEA require all municipalities to include bicycle and pedestrian components in their transportation plans. Federal policy assigns the responsibility for developing the plan to local units of government with populations over 50,000.

The adopted plan will be part of the Billings Urban Area Transportation Plan, the State Transportation Improvement Plan (STIP) and the annual Transportation Improvement Program (TIP) for Billings /Yellowstone County. Bicycle plan priority projects will be updated annually through TIP.

This bike plan does not guarantee a specific funding level, however the adoption of *BikeNet*

plan allows bicycle projects to be in line for funding and insures a connected and coordinated system of transportation facilities. As Billings heads toward the year 2000, funding sources we cannot now anticipate for bikeways may become available. Many, like ISTEA and CTEP, will require communities to have an adopted plan before applying for funding. By adopting BikeNet, Billings will be poised to take advantage of such monies, and direct funds to priority projects.

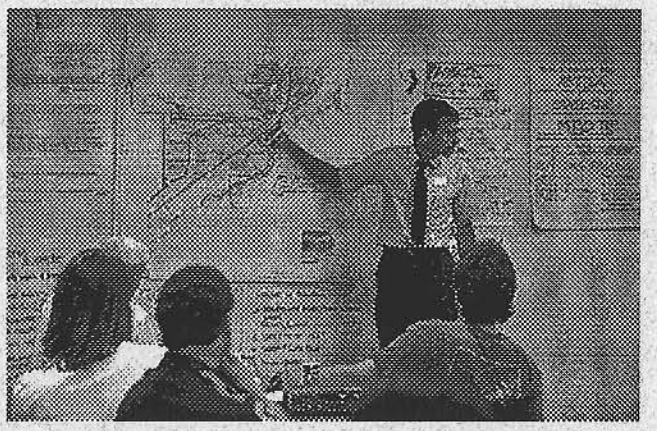
Use of the Plan

BikeNet is a strategy for developing a comprehensive bicycle program to be implemented over the next 15 to 20 years. It is not a capital improvement list, engineering design plan, nor a detailed program budget. Further design and analysis will be needed to complete specific projects. The Plan gives direction to the development of a physical bicycle system including on and off street facilities and programs.

The Plan provides a framework for decision making on contemplated and future projects. Every year the public and private sectors spend millions of dollars on infrastructure development, improvements and maintenance. BikeNet is a catalyst to encourage "Bicycle Thinking" and include bicycle components in new developments, economically and efficiently.

Who Developed the Plan?

BikeNet was developed under the authority



Councilman Kevin Justis participates in technical workshop

of Yellowstone County Planning Board and funded by a transportation planning grant from the Federal Highway Administration (FHWA). The plan was developed through an active public participation process, including technical workshops, public meetings, open houses, weekly informal brown bag lunches and government agency reviews. The planning process was facilitated by a team of consultants and overseen by an advisory committee comprised of local officials, representatives of the public, and city/county departments of planning, parks, and public works. The consultant team included transportation planners, landscape architects, bicycle planners, bikeway administrators, and engineers. Extensive public involvement insured the plan reflected the vision and values of Billings area citizens.

Implementation Schedule and Costs

The key to making BikeNet a reality is persistent and coordinated pursuit of all parts of the plan by public and private interests working

together with common vision. The plan was conceived and is organized for implementation. Such implementation will occur as a normal part of the growth of the region through planning processes, infrastructure expansion and maintenance, policy changes, new programs as well as specific capital improvement projects.

It is important to understand that the recommendations on policies, procedures and standards included in the Plan do not require a large capital infusion. These recommendations may often be incorporated as part of the day-to-day business of various city and county departments, institutions and bicycle use advocacy groups.

The construction price of facilities is affected by land, material, and labor costs, construction methods and schedules as well as the size of a project. Because BikeNet is intended to be implemented over 15 to 20 years, it is neither appropriate nor possible to assign a construction and implementation cost. Preliminary estimates for near term, specific projects are, however, included for the purpose of budgeting and securing funding for priority projects.

A variety of funding alternatives are outlined in the report. The community should remain actively involved in the prioritization of bikeway projects, allocation of fiscal resources, and selection of appropriate funding sources and levels. The length of time needed to implement the Plan directly depends on the level of support within the community and the resulting commitment of resources by city and county governments.

What Are The Benefits Of Bikeways To The Community?

Integrating bikeways into the community infrastructure will improve the everyday quality of life for the people who live and work in the Billings area. Not only will bikeways help reduce negative environmental impacts that accompany fossil fuel-use transportations systems, bikeways will increase the enjoyable living options the community has to offer. An improved bicycle system will help improve safe access to community resources for youth and other segments of the population who cannot or chose not to use motorized transportation.

People who have the ability to move to desirable living environments will find Billings competitively a more attractive place to live. Tourists also are increasingly attracted to communities where they can participate in a broad range of outdoor activities. Given the geographical diversity of the area and the abundance of significant historic and cultural sites, Billings has the opportunity to further capitalize on the economic benefits of recreational tourism--a clean and lucrative growth industry.

Reducing the number of single-occupancy vehicle trips improves air quality, reduces consumption of limited fossil fuels, lessens traffic congestion and potentially reduces the costs and negative environmental impacts associated with construction and maintenance of additional vehicle lanes. The ability of communities to continually devote more funds and land to facilities for motorized traffic is limited.

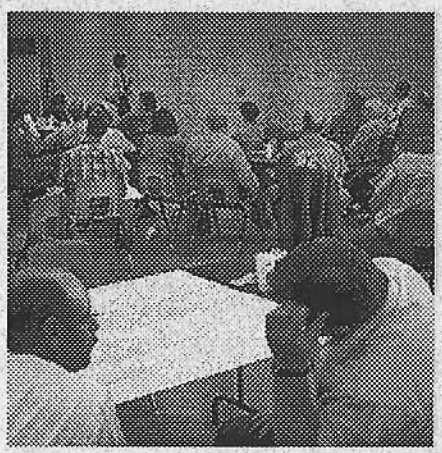
BikeNet Goals

The early efforts of the planning team and the advisory committee focused on reviewing the status of bicycling locally, statewide, regionally and nationally, and establishing goals for the Plan.

Project goals and objectives were developed, reviewed, refined in early workshops with the public, and approved by the advisory committee. Goals of BikeNet and the planning process are as follows:

Serve the public by developing a comprehensive bicycle plan for the Billings urban area that emphasizes safety, environmental preservation, resource conservation and cost effectiveness. Encourage county-wide adoption of the recommendations.

Assist the community in visualizing the role bicycles, as an alternative transportation mode, may serve in meeting access demands identified in the 1990 Transportation Plan and develop strategies for achieving this vision.



Planner David Groshens visits with Dean Hall, BBWA Canal Superintendent at technical workshop

Objectives to help achieve these goals are:

1. **Employ a participatory planning process**, to mobilize public support for bicycling, taking advantage of the opportunity this project presents to **encourage and promote** bicycling.

2. **Plan to improve the "Bicycle Friendliness"** of the community through physical planning and design for bikeways and through bicycle safety education, traffic rule enforcement, and bike use encouragement programs. Recommend policies, programs, and facilities (including planning and design standards) to encourage evolution, development and maintenance of an efficient, safe and environmentally pleasing bicycling environment.

3. **Develop a plan which will gain broad based support** throughout the community by providing multiple benefits with the least fiscal impact. Explore and pursue opportunities to interface with other community organizations and planning processes including public works, utilities, parks, and service clubs, the Yellowstone River Parks Association (YRPA), environmental advocacy groups, private developers, the Chamber of Commerce, and other special interest groups.

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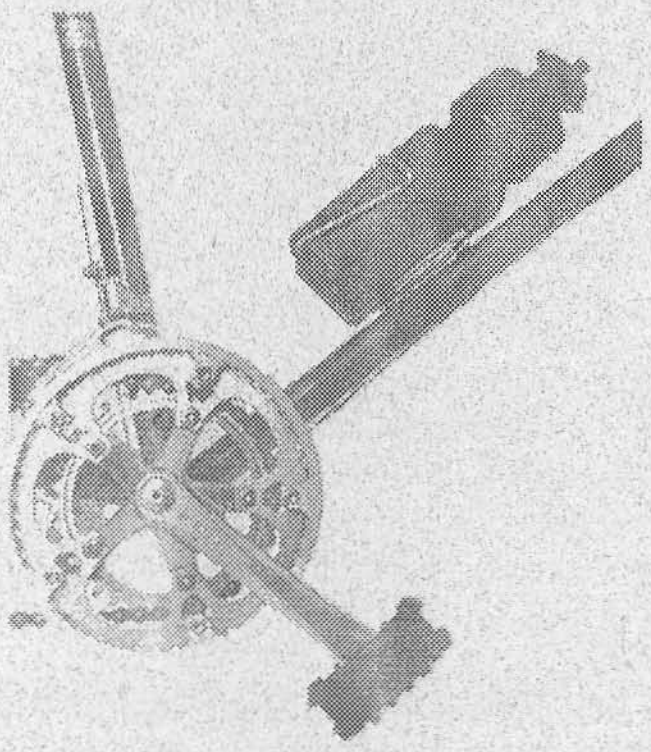
II. THE PLANNING PROCESS



Approach

A phased planning process was employed with monthly reviews by the advisory committee. Early steps involved research, inventory and analysis to identify issues, resources, opportunities and constraints to the creation of a Billings bikeway system. Community resources were documented, and draft recommendations in the form of issues and action strategies were developed, reviewed and refined.

Issue Identification

The team researched national, regional and local trends through literature reviews, interviews with bicycle coordinators, public officials and government agencies. Local plans, policies, and processes were reviewed. Publicly accessible lands and public land ownership, schools, parks and general land use were mapped. Members of the consultant team, advisory committee and city and county staff participated in a field trip to Colorado to review successful, state-of-the-art facilities and planning processes in Denver and Boulder. Bicycle transportation consultants from the latter two communities and Seattle visited Billings to help with the local on-site analyses. The inventory process emphasized in-field work to insure a realistic perspective on the existing opportunities and challenges.

The participatory planning process included a series of advertised workshops and open houses. Bicycle enthusiasts, community leaders and the public were also contacted and invited to participate. Those who came to the meetings expressed hope for a non-exclusionary, long-range, practical plan that would achieve community support without compromising too much of the bikeway supporter's vision. There was also consensus on the importance of sustained community involvement in developing a comprehensive bikeways plan that would address education, traffic enforcement, engineering and bike use inducements.

The most common concern expressed by participants in both the public and technical workshops was a fear the Plan would not be implemented. Reasons cited included lack of funding, lack of political support, and insurmountable safety, security and liability problems.

National , Regional and Local Trends

In the last 20 years, bicycling has increased across the country for both recreation and commuting purposes. Improvements in equipment, available facilities, and bike-related programs and policies have all contributed to the increase. Other factors contributing to the popularity of biking are sensitivity to the environment, increased interest in physical fitness and a national transportation policy encouraging, recognizing and funding bicycling as a legitimate transportation mode.

The National Bicycling and Walking Study conducted by FHWA, and published in 1994 found that by the end of 1993, there were 100 million bicycles in the United States. This

represents an increase of over 33% in the last 10 years. Ownership of bicycles is increasing. In 1993, 13 million bicycles were sold in the United States, the highest levels in 10 years. In a recent Harris Poll, one-half of American adult bicyclists said they would commute to work or school at least occasionally if there were safe places to ride. The same survey showed that nearly 60% of all Americans want the government to devote more funds to make the transportation system more bicycle friendly.

Bicycle advocates argue that the potential for shifting from driving a car to riding a bicycle is significant because 25 percent of all trips are one mile or less, 40 percent are two miles or less and 66 percent are 5 miles or less.

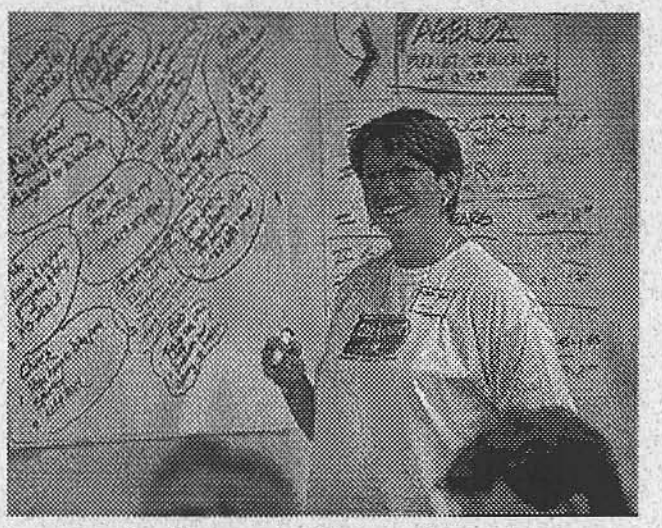
Local support for cycling is evident in the increasing number of bicycling events, bicycle clubs, CTEP trail and bike path proposals, growing interest in the Yellowstone River Parks Association and community participation in BikeNet.

There are few statistics on demand for and use of bicycles in Montana for trips other than journey-to-work data collected in the 1990 Census. Journey-to-work trips are estimated to represent only 10% of trips made, and this data indicates just under 1% of all journey-to-work trips in Montana were by bikes. Although low, bicycle use for journey-to-work trips in Montana is twice the national average. In communities such as Seattle, Boulder and Denver which are planned for and encourage more bicycle use, bicycle use is increasing rapidly enough for the city administrators to allocate a large portion of the transportation budget for alternative transportation modes including bicycles.

Review of current public policy and processes reveals many opportunities in Billings to improve bicycling. Opportunities are lost because there are no policies, processes, or reliable funding programs in place to routinely consider the potential of bikeways in new development and infrastructure projects.

Public Participation

The proposals in BikeNet are largely based on the direction received during six public and technical workshops, monthly advisory committee meetings and the consultant team's bicycle planning experience. Planning participants

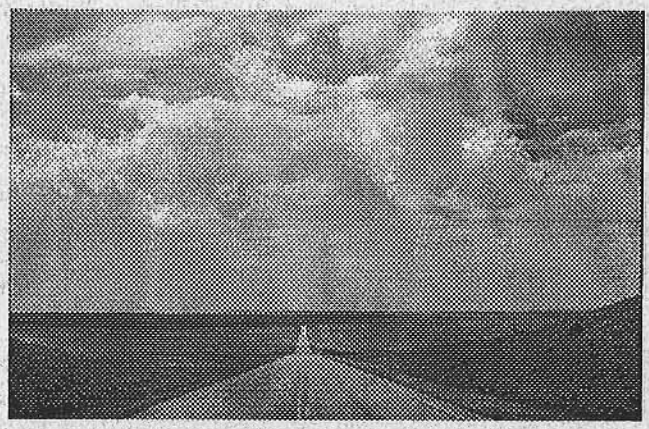


Sara Jane Maclennan facilitates one of five workshops

included the Billings bicycling community, public officials, city and county staff, and citizens interested in increasing the opportunities for bicycling in Billings. Invitations to meetings were sent and BikeNet planning meetings were publicized in the media. The meetings were conducted in a workshop format allowing

participants to contribute ideas. Through a series of exercises and informal surveys, participants expressed opinions on the availability and status of existing bicycle-related facilities and programs; recommended on and off street bicycle routes; prioritized the relative importance of possible bikeway programs, policies, projects, and facility improvements; and suggested possible funding sources.

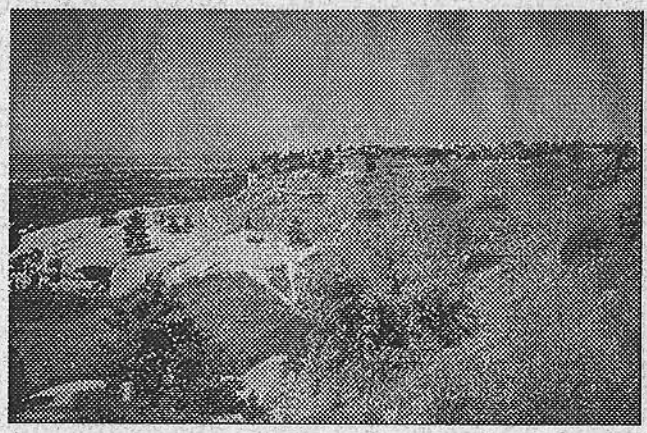
Workshop participants confirmed what nation wide surveys have indicated: the decision to ride a bicycle is most influenced by safety factors such as motorists obeying laws, adequate street width, and availability of secure bicycle parking. Another important factor is provision for taking bicycles on city buses. Other influences include availability of bikeway maps and advice on routes, training in bicycle safety and repairs, and access to local scenic geographic areas.



Rural Highways Offer Bicycle Touring Opportunities

Resource Identification

Community resources identified and documented early in the planning process were the environment, programs and people, and facilities.



User Made Trails Offer Bicyclists Magnificent Views Of The Valley

The Bicycling Environment

People bicycle for recreation, transportation and touring. Billings is an outdoor city with a climate conducive to bicycling and inherent natural beauty. Few places have such tremendous but unrealized opportunities for bicycling. Geographical diversity abounds including rimrocks, the Yellowstone River and its breaks and tributary creeks, open agricultural lands,

County Roads Let Cyclists Experience The Regions Agricultural Heritage

rolling hills and buttes, riparian areas and vast prairies. In addition there are attractive streets, residential areas, a central business area as well as many cultural/historic sites and an exemplary park system. Several open space corridors with bicycle path potential exist including agricultural and storm drains, canals, rail and highway corridors. The BN/MRL rail and BBWA Canal offer direct transportation routes with excellent opportunities for recreation and interpretation of the region's history.

Limited vehicular access, abundant open space, and the relatively undeveloped character of the Yellowstone River and its diverse environments are assets conducive to development of an off-road bicycle path. The four existing and one proposed interstate highway interchanges in the Billings area provide opportunities for commercial services, vehicular access and shared trail head facilities paralleling the river.

Metra is located at the confluence of the Yellowstone River, the railroad, Billing's distinctive rimrocks, the Alkali Creek drainageway, and several highways. The proximity of Metra to Downtown, ample parking, and its large public land holding adjacent to these resources invites the development of this area to include bicycles in its recreational opportunity planning.

Programs & People

A few competitive events occur in Billings annually, including the Big Sky State Games, RiverFest, and the Peaks to Prairie Triathalon. There are over a dozen cycle/sporting goods shops, a few organized cycling clubs, one racing team, a contingent of experienced bicyclists who commute, and many basic cyclists who bike predominantly for recreation.

Published routes include off-road mountain trails and touring routes looping along county roads and state highways outside of the Billings metropolitan area. No suitable bicycle maps and very limited bicycle tourism information are available for the community area. Bicycle safety programs are offered each year by the Yellowstone County Traffic Safety Task Force and by the schools and cycling clubs.

Existing Facilities

No paved off-road bicycle facilities or on-street designated routes exist in the Billings community area. However, both Yellowstone County and the City of Billings have approved use of CTEP funds for off-road routes in the Heights, on a section of the Yellowstone River, and at Metra. There have also been several other trail and bike path proposals the Planning Board has delayed action on, pending a bikeways master plan and design standards.

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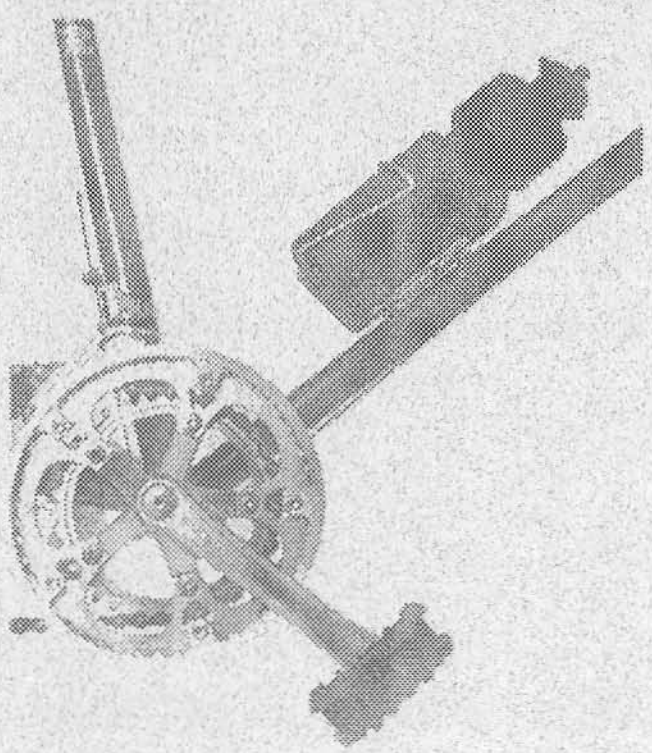
III. THE PLAN



Introduction

The key to making BikeNet a reality is active and coordinated pursuit of all parts of the Plan by public and private interests seeking to integrate its common vision into the community. As previously stated, such actual implementation of a realistic plan was the highest priority expressed by a majority of more than 300 planning workshop participants. Conversely, the most commonly expressed concern was that **"the plan won't be implemented"**. To address this concern, the Plan was developed stressing issue resolution and actual on-the-ground implementation.

The Plan is organized into three sections: Policies, Programs, and Facilities. Each section presents a brief discussion of issues followed by recommendations and action-oriented implementation strategies. Through adoption of this Plan, the community is taking the important first step toward implementation of BikeNet. An on-going interest and commitment by the public and by local government is needed to continue to make this shared vision a reality.

INSTITUTIONAL POLICY

Issues

Public involvement and "Bicycle Friendly" governmental policies at federal, state and local levels are required for successful implementation of a quality bicycle transportation system.

As a result of public support, established planning processes, and a government commitment to progressive transportation policy, the Billings urban area boasts quality air, bus, street, highway and sidewalk systems. This same commitment will be required to implement a bicycle plan that is necessary and complementary to the existing transportation systems.

Transportation policies to date have not addressed bicycling and the recently validated, strong public support of bikeways. The obvious result of this lack of bicycle planning integration in the policy definition process is an inadequate bicycle transportation system, sub-standard bicycle-related improvements, and sometimes inconsistent or inappropriate design standards.

Reasons for the oversight are numerous including:

1. *Limited opportunities for bicyclists' involvement*
2. *A general lack of knowledge about bicyclists needs*
3. *Not all adopted construction standards are bicycle friendly*
4. *No "Bicycle Checkoff" required as part of the planning process*
5. *Lack of or limited review of public works and highway projects for bicycle considerations*
6. *Lack of coordination between government*

agencies and departments concerning bicycle improvements possibilities

7. *Bicycle friendly policies and design standards have not been adopted and institutionalized*

Accommodating bicycles does not have to add significantly to the cost of a project if considered in the early phases of planning. Many cities successfully and cost effectively integrate bicycle facilities into utility, flood control, storm water management, park, recreation, and transportation projects.

Strategy

A1. CONTINUE PUBLIC INVOLVEMENT AND INCREASE PUBLIC REPRESENTATION IN THE PLANNING AND IMPLEMENTATION OF BIKENET

Actions

A1.1. Appoint a Citizen Bicycle/Pedestrian Advisory Committee

Establishment of a Citizen's Advisory Committee is strongly recommended. An Advisory Committee comprised of local government officials, city and county staff, the Planning Board and representatives of interest groups and bicycling community was formed to oversee development of BikeNet.

During the planning process, numerous private citizens who care about bicycling and the community expressed interest in serving on a Citizen's Advisory Committee. The Committee should be coordinated by a government staff member, preferably an experienced Bicycle Coordinator (see Action 2.3 below). Benefits of such a committee that have been documented by other communities include availability of technical expertise (from knowledgeable citizen members) at minimum cost and continuity of committee members regardless of governmental staff or political changes.

A1.2. Encourage people with bicycle/interests to serve on government boards

The activities of the traffic control and transit, planning, zoning, parks and other similar boards have the ability to influence the realization of community bikeways. Including volunteers with bicycle interests on these boards will assist communication between planning staffs, local government, and the general public on bicycle issues.

A1.3. Continue to inform the public of transportation options and survey public opinions on preferences

Most citizens are unaware of, or perceive limited effective opportunities to express preferences relative to the livability of their community and how the budgeting and expenditure of public funds affect livability. An informational, education program focused on the benefits of bikeways should be a responsibility assigned to the Bicycle Coordinator.

Include questions relative to bicycling as a transportation option in government-sponsored community surveys. As the rate of growth and change accelerates, government's responsibility to inform and educate increases in both complexity and importance. Public administrators have found that an informed citizenry is usually better energized, involved, and cooperative and often less reactionary.

During the BikeNet planning process, participants were asked to express their opinions on a variety of transportation and land use issues. The surveys from these meetings indicated public support for the following:

1. *Expenditure of federal, state and local funds for bicycle facilities, education and promotion programs*
2. *Reallocation of a portion of local transportation and park funds for bicycle facilities*
3. *Land banking and acquisition of recreational use rights for future bicycle corridors*
4. *Flexible or reduced street-width standards on some streets to accommodate "sharing" of streets by cars, bikes and people*
5. *Traffic calming (planning and design to slow vehicular traffic down) on some residential streets to promote, comfortable, safe, shared use by children and other pedestrians and vehicles*
6. *Reasonable increases in taxes to implement BikeNet if other funding sources are exhausted*

A1.4. Increase and improve public-private partnerships in bikeways planning and implementation

Throughout the BikeNet planning process, several private associations expressed interest and support for the Plan including the Yellowstone River Parks Association, financial institutions, museums, bike shops, cycling clubs, service clubs, Montana Tradeport Authority, Montana Avenue Coalition, Chamber of Commerce, and the Downtown Billings Association. City and county staffs affecting bikeways planning need to recognize, validate, support and work with these groups, something most easily done through the creation of a Bicycle Coordinator position.

Partnership opportunities include technical planning assistance, cost sharing, foundation sponsorship, financial incentives, implementation, and maintenance of facilities as well as safety education programs, promotions, and support of bikeway planning, implementation, and use.

Strategy

A2. ADOPT BICYCLE FRIENDLY LOCAL GOVERNMENT PROCESSES AND STANDARDS

Actions

A2.1 Adopt, refine and implement BikeNet

Creating and maintaining an effective, safe and convenient city-wide bicycle system re-

quires on-going attention. Without proper planning and predictable funding, many opportunities to use routine street, development and utility projects to cost effectively implement or improve a system, will be lost.

Although funds for infrastructure improvements for bicycles are limited, progress can be made just with better cooperation and coordination between various staffs. Again, this function could be facilitated by a Bicycle Coordinator.

A2.2. Commitment to Funding

Predictable bicycle funding should be programmed for bikeway easements, land acquisition, and physical and program improvements. Periodically program Transportation Planning Funds to update BikeNet on a regular basis. Include a line item in the various park's, utility's, and public work's annual budgets to take advantage of opportunities to improve the bicycle transportation component of the community's transportation system.

A2.3 . Appoint a local staff Bicycle/Pedestrian Coordinator

A single recognized, designated source for planning and coordination of bicycle interests is needed to avoid having the plan "sit on the shelf". A designated, experienced Bicycle Planner staff position in either the Planning or the Public Works Department will help insure the motor vehicle, pedestrian and bicycle systems work together. Duties of the Coordinator might include:

1. *Implementing and promoting BikeNet*
2. *Evaluating existing and new facilities and programs*
3. *Reviewing new plans, public and private construction, reconstruction and pavement management projects*
4. *Coordinating all public bicycle-related projects.*
5. *Securing funding from state, federal, local and private sources for bicycle-related facilities, education and promotion.*
6. *Bicycle-related data collection and program evaluation*

(Refer to FHWA Publication No. PD-93-019, Case Study No. 2 The Role of Bicycle and Pedestrian Coordinators for detailed description of responsibilities and a Model Program.)

A2.4. Require bicycle "Check Off" on all private site development projects and subdivision plats

Adopt a policy to ensure the Bicycle Coordinator is involved in the review of all private development projects. On these projects, work with the developer to plan for and accommodate bicycles in consideration of parkland dedication, site design, access, etc. Establish realistic requirements for construction of bicycle-related facilities and provide incentives for private developers to do more. Minimum design standards for rural and urban areas should be incorporated into adopted standards and regulations, including subdivision and site development ordinances.

A2.5. Require bicycle "Check Off" on all public infrastructure projects

Adopt a policy to ensure bicycle planning expertise is included on all public projects. Integrate bicycle considerations into all new street and highway projects. Involve the Bicycle Coordinator in review of all planning and construction projects. Through early design reviews, opportunities can be identified, planned and implemented at lower cost than later. Improve the coordination efforts between governmental departments that can acquire easements and those that construct and maintain corridors with potential for future bikeway development. At a minimum alignment, grading, and the provision a continuous, improved surface--including structures required to bridge drainages should be required.

A2.6. Work towards the integration of recognized National Standards into local design and maintenance standards for bicycle facilities.

Include a maintenance review of bikeway facilities and assign responsibility for on-going maintenance, prior to construction. Rather than maintaining separate design standards for bicycling, integrate bicycle standards for on-street routes into already adopted street engineering standards. Bicycle-related considerations need to address street widths and related appurtenances including drainage grates, signage, drive approaches, bridges, culverts, etc.

A2.7. Enforce parking and traffic laws

The priority of this action is partially addressed by education and training, specifically encouraging riding according to the rules of the road. Work with the police and sheriff to enforce traffic rules.

A2.8. Revisit the *1990 Billings Transportation Plan* to consider alternative management strategies to reduce single occupancy vehicle trips and preserve environmental quality

Research indicates vehicle traffic will expand to fill capacity. All cities with model transit and bicycle facilities have made a conscious effort to reduce auto accommodations through alternative transportation management strategies, making it less convenient to drive or use specific routes. These management strategies help address the continual need to accommodate more and more vehicular traffic.

The current Transportation Plan and existing street standards are based almost solely on the efficient accommodation of all motor vehicles on all streets, regardless of the impact on the adjacent residential neighborhoods, environmental quality, or bicycles. Incorporate quality of life objectives into the motorized vehicle transportation planning objectives.

Encourage the public to become involved in alternative transportation, and establishing priorities for transportation-related expenditures.

A2.9. Encourage Intergovernmental and Interdepartmental cooperation to plan and implement BikeNet through multiple use and multiple benefit projects

Most successful off-road bicycle systems are implemented using a variety of funding sources and conceiving projects that address multiple issues and provide multiple benefits. Encourage more interdisciplinary and intergovernmental collaboration on planning and design of infrastructure projects including bikeway, greenways, drainage, utility, recreation, and paving projects.

A2.10. Revise street standards to accommodate and encourage shared use of streets by bicycles, pedestrians and motorized vehicles

Recommended revisions to existing city standards are outlined in the Facilities portion of this Plan. These standards should be incorporated into adopted street standards, subdivision ordinances, and site development regulations; the recommendations should not remain as independent "Bicycle Standards".

Outcomes of the planning process as well as AASHTO guidelines recommend *"To varying extents, bicycles will be ridden on all highways where they are permitted. All new highways, except those where bicycles will be legally prohibited should be designed and constructed under the assumptions that they will be used by bicyclists"*. Street standards should be modified to accommodate but not always encourage bicycling on all streets.

A2.11. Encourage development of bicycle parking facilities through provision of facilities on public properties and by adopting ordinances and developer incentive programs

Install sturdy, easy to use parking facilities in parking garages, on public properties, and bus and MET transfer stations. Encourage schools, universities, shopping centers, downtown merchants, multi-family developments, office and business complexes and employers to provide secure parking. Develop incentive programs to improve bicycle parking throughout the community. An example of such incentives would be providing vehicular parking space credits in return for providing on-site bicycle parking.

A2.12. Establish multiple use corridors

Select and develop off road corridors for bicycle transportation with the objective of providing multiple benefits including utilities rights of way, irrigation canals, preservation of water quality and wildlife, flood control, and increased recreational opportunities.

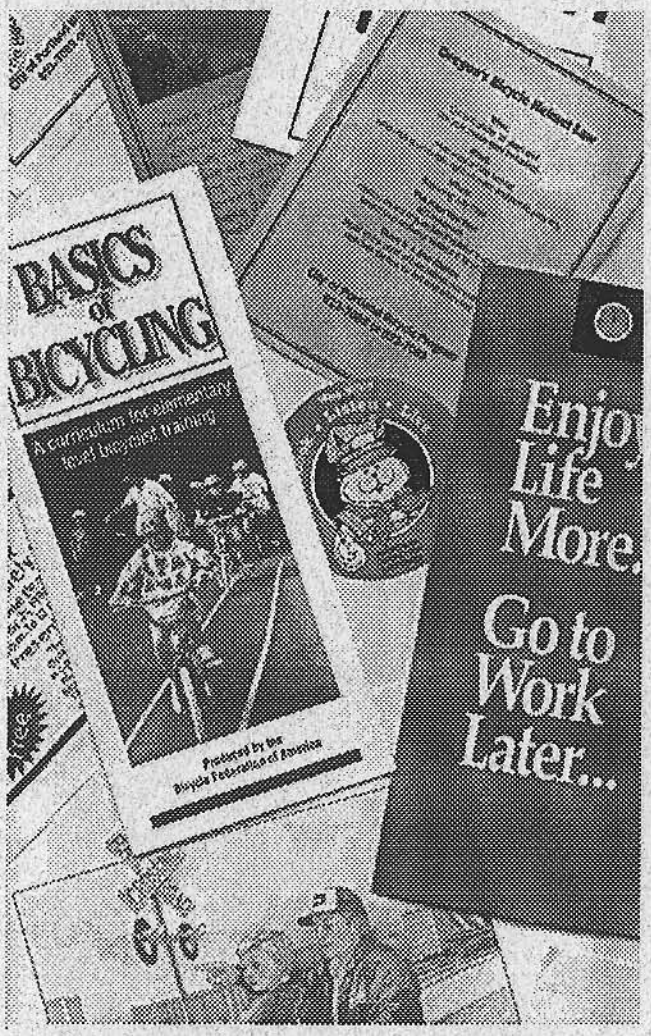
Alkali Creek Corridor Could Be Developed For Multiple Use

A2.13 Strengthen bicycle component of the Yellowstone County Comprehensive Plan

When the Yellowstone County Comprehensive Plan is amended, include a goal of increasing bicycle commuting. Strengthen the bicycle component of the Comprehensive Plan by referencing in the following sections the benefits of bicycling:

- *Self-contained Neighborhoods*
- *Provide Appropriately Located Educational Facilities*
- *Bicycle Planning*
- *Public Transportation*
- *Air Quality Impact*
- *Energy Impact*
- *Protect Air Quality*
- *Noise*
- *Land Use*
- *Landscaping*
- *Trails*

A more detailed discussion of related issues is included in the BikeNet Project Notebook.



Safety Education And Encouragement Programs Could Influence Bicycle Ridership And Safety

A2.14 Monitor Montana State policy, programs and plans

The Montana Department of Transportation in currently in the process of developing bicycle transportation policies through the statewide transportation planning process, *TransPlan 21*. Local governments and citizens should monitor these policy developments to insure local authorities retain the power to plan and prioritize bicycle improvements in their jurisdictions.

Monitor other programs and State planning activities that could impact BikeNet, including Fish, Wildlife and Parks Departments land conservation and development programs, the State Trails Plan, and the Department of State Lands' Recreational Land Use Policies.

PROGRAMS

Issues

Improved programs could significantly influence more people to ride bikes, ride safely and reduce the number of motor vehicles impacting the transportation system

Local bicycle education, information, traffic code enforcement, and promotional efforts are few. Some safety programs are offered through the schools, by bike clubs and safety task forces. Better educational and information programs do not require a large capital infusion. Many of the recommendations can be incorporated as part of the day to day business of various City departments, schools, clubs, task forces and service organizations.

Many cyclists do not know that, legally, bicycles are considered vehicles and are expected to obey vehicle traffic laws. Many motorists do not realize bicyclists are legitmate users of the road. If enforcement of laws were stronger, bicyclists' and motorists' respect for the law would be greater.

Strategy

B 1. ADOPT A POLICY REQUIRING THE LOCAL BICYCLE COORDINATOR TO PARTNER WITH COMMUNITY ORGANIZATIONS AND OTHER AGENCIES TO SPONSOR BICYCLE PROGRAMS.

Actions

B1.1. Partnering with the community on education and encouragement programs

Potential partners include: youth and health associations, clubs, schools, Safety Task Force police, and sheriff organizations

B1.2 Partnering with medical and health community

Incorporate bicycle safety and bicycle fitness programs into community health education and promotions programs.

B1.3. Partner with the schools

Develop programs to encourage bicycle use and safety education through schools and parks/recreation programs.

B1.4. Partner with MET Transit

Promote bicycling and mass transit as transportation alternatives through the "Livable Cities" Program and alternative transportation promotions.

B1.5. Partner with museums

Include bicycle trips in out reach education and museum interpretive programs. The Western Heritage Center has expressed support for an historic trails program.

B1.6. Co-sponsor or coordinate bicycle events.

Collaborate with other organizations and events to improve public awareness of bicycling. Events might include:

- *Bike the Bakeries, Bike to the Bair, The Fair*
- *Museum, home,historic site and garden tours*
- *Media promotions and public service announcements*
- *"Bike to Work Days", and other employer incentive programs*
- *"Bike-A-Thon" fund raisers*
- *"Bike Friday" in conjunction with "Gazette Blue Jean Friday" and Chamber "Western Friday" promotions*

B1.7. Establish a Bikeways Information System

Including maps and attractive, legible directional and informational signage. Route designations and adopting a classification system will encourage bicycle use.

B1.8. Develop a postcard "Spot Improvement Identification Program"

Solicit information on needed improvements in cooperation with bicycling clubs and shops.

B1.9. Develop corporate and service group programs

Establish "Adopt a Trail" or "Sponsor a Trail" programs similar to highway Adopt a Highway program.

B1.10. Promote bicycle-bus trips with "Lock and Ride" facilities and promotions

Explore means of transporting bicycles on buses.

B1.11. Work with law enforcement

Increase awareness of and commitment to reduce unlawful and unsafe motorist and bicyclist behaviors.

B1.12. Encourage bike shops to provide bicycle skills and repair instruction

Sponsor classes, training rides, publications, and other education programs.

B1.13. Monitor Bicycle accident statistics

Use information gained to make appropriate improvements to reduce accidents.

B1.14. Work with private businesses and public and private institutions to share parking and restroom facilities.

Examples include post offices, banks, public parks, Metra, Chamber of Commerce, motels, health facilities, etc.

FACILITIES

Overview

This section outlines planning processes, issues and recommendations for implementing a comprehensive bicycle facilities plan. The Plan proposes a comprehensive approach to facilities to promote safe and pleasant travel. The proposed system is meant to be dynamic, able to grow with the community and change as opportunities arise. Opportunites will be provided for users of various ages and abilities.

Recommended routes are illustrated on the included maps titled *BikeNet On Street Plan* and *BikeNet Off Street Plan*. The recommendations included were arrived at with input from the community, governmental staff and community leaders on existing conditions, objectives, issues and opportunities.

Objectives

Community and governmental expectations of the plan were translated into the following objectives. These objectives guided development of the facilities plan and implementation recommendations.

1. *Develop a realistic improvement plan for bicycle transportation*
2. *Safer accommodation of bicyclists on all streets*
3. *Plan a system of facilities to meet needs of all users and experience levels by providing linked networks of on street and off street routes*
4. *Encourage bicycle use on selected on-street routes through designation and design*
5. *Recommend a classification system and develop planning standards for all classes of on street and off street facilities*
6. *Recommend uniform bicycle friendly engineering design standards*
7. *Recommend bicycle friendly traffic management strategies*
8. *Document recommended bicycle facility planning and design processes and implementation strategies.*
9. *Identify and prioritize specific improvement projects*
10. *Identify deficiencies in the bicycle transportation system*

Planning Process

Identify User's and User Needs

Potential users of the facilities were identified as children, basic and advanced bicyclists. Their purposes for making bicycle trips included commuting, recreational rides and long distance touring for exercise, training and pleasure, racing, and mountain biking. Route selection criteria and priorities were documented for the various user groups.

Table 1. Bicyclist's Route Selection Criteria and Priorities

TABLE 1 BICYCLISTS ROUTE SELECTION CRITERIA AND PRIORITIES						
ROUTE SELECTION CRITERIA	Advanced	Basic	Children	Touring	Racing	Mt. Bikes
SAFETY	H	H	H	H	H	M
CONTINUITY	H	H	H	H	H	H
ACCESSIBILITY- Off Road Routes	M	H	H	H	M	H
ACCESSIBILITY-All Streets	H	M	M	M	H	L
OVERCOME BARRIERS	H	M	M	H	M	L
MAINTENANCE & SURFACE QUALITY	H	M	M	M	H	L
TRAFFIC VOLUMES	L	H	H	M	M	M
TRAFFIC SPEED	L	M	H	M	L	NA
SCENIC QUALITY	L	H	M	H	M	H
ENVIRONMENTAL QUALITY	L	H	M	H	M	H
LIMITED ON STREET PARKING	H	M	M	M	M	NA
DELAYS / STOPS	H	M	L	M	M	M
DIRECTNESS	H	M	M	L	M	L
TRUCK & BUS TRAFFIC	L	M	H	M	M	NA
ACCESS CONTROL	M	M	M	M	M	NA
LANE DESIGNATION	L	M	M	L	L	NA
BICYCLISTS FACILITY PRIORITIES						
SYSTEM IMPROVEMENTS	H	H	H	H	H	M
INTER DISTRICT CONNECTORS	H	M	M	H	H	M
ACCESS TO RIMS, RIVER, CANAL, DRAINS	M	H	H	H	M	H
ACCESS TO PARKS	M	H	H	M	M	H
INTER NEIGHBORHOOD	M	H	H	M	M	L
OFF STREET ROUTES	M	H	H	H	L	H
ACCESS TO COMMERCIAL	H	M	M	M	M	L
ACCESS TO SCHOOLS	M	H	H	L	L	L
ACCESS TO EMPLOYMENT	H	M	L	L	L	L
SECURE PARKING	H	M	M	L	L	M
INTERFACE WITH TRANSIT	H	M	M	L	L	M
IMPLEMENTATION PRIORITIES						
PLAN ADOPTION	H	H	H	H	H	H
SAFETY EDUCATION	H	H	H	H	H	M
CORRIDOR PRESERVATION	M	H	H	M	M	H
SYSTEM IMPROVEMENTS	M	H	H	H	L	M
MAPPING ROUTE SUITABILITY	H	H	H	M	L	M
ENCOURAGEMENT PROGRAMS	H	M	H	M	M	L

H = High
M= Medium
L= Low

Existing Conditions

Most bicyclists and potential bicyclists in Billings cited concern about the unsafe conditions and lack of facilities as the greatest impediments to bicycling in Billings.

Existing bicycle facilities are limited, consisting of undesignated shared roadways, short sections of sub-standard paths, unimproved trails along the rims, and mountain bike trails constructed by YRPA in and near Riverfront Park. Many of the existing sidewalks in parks and residential areas are shared by bicyclists and pedestrians.

Although not recommended by any current national standards, the *City of Billings Sidewalk Master Plan* recommends shared use of sidewalks by bicyclists and pedestrians. AASHTO gives a detailed discussion of safety reasons for not providing shared bicycle/ sidewalk facilities adjacent to a public street ROW. City engineers should review national research on accident data for such facilities, discourage this configuration adjacent to streets, and when shared use is necessary, limit use of sidewalks for bicycling to youthful cyclists (defined as those under 13 years of age) and where there are existing boulevards.

The County constructs road widths to standards recommended by AASHTO. Current AASHTO standards recommend paved shoulders in rural areas for use by bicyclists and pedestrians. Unfortunately, many of the existing County roads have gravel shoulders and pavement widths narrower than recommended for the type and volume of traffic they carry.

Opportunities and Constraints

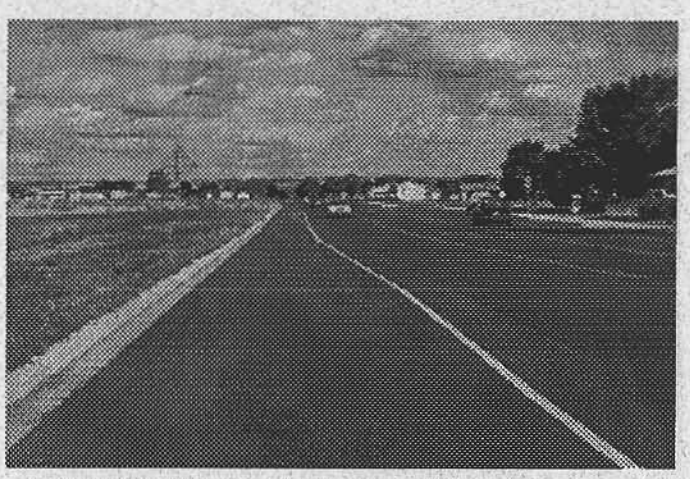
On-Street

Although no designated on-street facilities exist, generous street widths within the City of Billings could be designed to make cycling comfortable on all but the most heavily traveled arterials. Designation of routes and modifications to allocation of standard City street pavement widths will yield a workable system on-street routes within the city limits.

County standards for pavement width are currently under review. Existing standards will need to be modified to provide additional paved shoulder width for shared use by vehicles and pedestrians.

Although implementation of on-street facility improvements will be most economical, there is equal or more interest by the community in developing an extensive off-road system.

Grand Avenue Is An Example Of A Difficult Street For Biking



Wide Street Standards Will Accommodate Bike Lanes

Off-Street

Several corridors with good potential to form the basis of an off-street bicycle system for transportation and recreation exist. Potential corridors include the rimrocks, the Yellowstone River and its tributaries (including Five Mile, Canyon, and Alkali Creeks), the BN/Montana Rail Link Railroads, the abandoned BN rail corridor in the heights, the BBWA Canal, and proposed Billing's west end storm drainage corridors. Other potential secondary corridors include the numerous canals, irrigation ditches, and drains; existing and proposed public utility

Wider Rural Roads Would Provide Shoulders For Safer Bicycle And Pedestrian Use

easements, private utility corridors; and city/ county drains. These same corridors could be developed as community greenway's providing multiple benefits including resource conservation, flood control and landscape enhancements.

Rail And Canal Corridors Offer Potential For Bike Paths

Issues

Liability Issues

Many of the off-street corridors, which the public has expressed interest in developing bike paths in will require acquisition of land easements or recreational use rights for path development. Legislative changes at the State level are required to indemnify public land managers and private landowners who grant the public recreational access.

Corridor Acquisition Issues

Governmental policies on use of planning processes and funds to acquire land or recreational use rights in proposed park, road, and utility corridors needs to be clarified. No policy exists to facilitate acquisition of additional street right of way for the purpose of bicycle transportation. Having mechanisms and funds to take advantage of opportunities is key to acquiring continuous corridors.

Design Standard Issues

Developing safe, functional, attractive, and environmentally appropriate bicycle facilities will require revisions of and additions to current city and county street design standards.

Implementing an on-street bikeways system within existing pavement widths may require modifications to lane widths and/or parking availability on some streets.

For example, Increasing current City and County standards for street widths by 10' to add two 5' bicycle lanes is not practical or

economical. This approach will involve excessive costs for additional paving, reconstruction of curbs on City streets, removal of trees, purchase of additional right-of-way and increases in long term maintenance costs. Negative environmental impacts of this approach may include increased cost and loss of the desirable street character (from a neighborhood / bicycle use point of view).

County standards for pavement width will need to be modified to provide additional paved shoulder width for shared use by bicycles and pedestrians.

Transportation Policy Issues

The current *Billings Urban Transportation Plan* was developed without full consideration of bicycle transportation and with the goal of encouraging and accommodating single occupancy vehicle use. Prior to this plan, no attempt has been made through city/county policy to try and convert or reduce the constantly growing number of single-occupancy vehicle trips.

Another challenge to implementing complementary bicycle and vehicle improvements will be to preserve scenic characteristics of the preferred rural cycling routes and make the urban routes more environmentally comfortable. This will require implementing some alternative traffic management strategies, traffic calming techniques, revised design standards and landscape improvements.

Preservation of the nature of neighborhood residential streets may involve reduced levels of service for motorized vehicles.

Accessibility and Management Issues

Environmentally responsive management of trails may require limiting levels of use or modes of access. For example horses and strollers may not be able to share the same trail.

Mountain bike trail supporters wish to see some trails remain narrow and unimproved.

Meeting the Intent of the American Disabilities Act may make restricting vehicles in some areas difficult. For example, some members of the community have requested Coulson Park and sections of Sword's Park be vehicle free.

Paths will cross jurisdictional boundaries. No entity currently exists to develop, manage and maintain paths in multiple jurisdictions on public and private lands. Creation of a Bicycle Coordinator position discussed in previous sections would help facilitate administration.

Facility Planning Process

Identify Planning Districts

Community Districts are identified based on physical characteristics, neighborhood task forces, and government and school district jurisdictions. These areas are illustrated on the map titled *Community Districts and Corridors*. Districts include Alkali Creek, Downtown, Lockwood and Vicinity, Heights, Southwest Corridor, South Billings, West Billings, Shiloh West and South Hills. Districts within the study area include urbanized, developing, and rural

areas, in both city and county jurisdictions. Route selection and designation considered current and future land use characteristics.

Identify Community Resources

Public lands, schools, school attendance districts, parks, and private lands open to the public were inventoried and mapped. This information was recorded on inventory worksheets. Some of the information is included on the BikeNet facility maps.

Assess Corridor Suitability

Potential on-and off-street linkages between districts, neighborhood and community resources were identified. The consultants reviewed existing and future streets as well as classifications proposed in *The Transportation Plan.* The existing and proposed corridors were evaluated for their existing and future suitability for use by bicyclists of varying levels of ability against the documented route selection criteria.

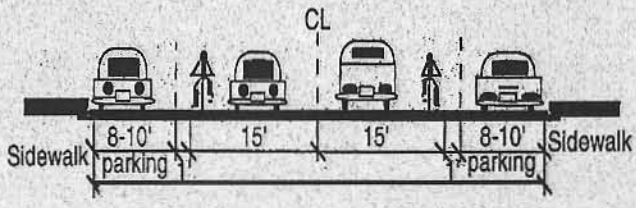
In general, collectors and minor arterials were determined to provide the best balance of characteristics identified as important by most users of on street routes.

The BBWA Canal followed by the Rail, Yellowstone River and Rim corridors were determined to be the most desirable off street corridors

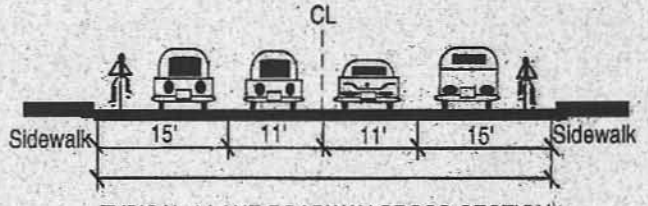
Review Existing Standards

Existing street widths and adopted street standards documented in the *1990 Transportation Plan* were reviewed. Modifications to standards and strategies for retrofitting bikeways into existing pavement widths were developed. These alternatives are summarized on Table 2. *A Summary of Current Street Standards; Recommendations for Retrofitting and Revising Standards.* Cross sections of several were developed and presented to the advisory committee. Illustrations of alternative street cross sections are included in this report and the project notebook.

The County surveyor was contacted regarding differences in County rural and urban standards. The County is in the process of updating road standards and will consider recommendations of BikeNet in the new development of new standards. (Refer to Table 2 and Section IV)



TYPICAL 2 LANE ROADWAY WITH PARKING



TYPICAL 4 LANE ROADWAY CROSS-SECTION

Retrofitting Bike Facilities Into Existing Streets May Involve Restriping, Lane Narrowing Or Removing Parking

Recommend Route Classifications

Several classification systems were reviewed. A decision was made to relate the proposed on-street bicycle route classifications to the vehicular street classification system used in the *1990 Transportation Plan.*

Taking direction from the adopted system, several classifications of on-street routes, characteristics, and users were developed and described. Standards, actual street widths, and traffic volumes were reviewed to determine modifications needed to develop facilities conforming to national standards for bicycles and vehicle lane widths. Yellowstone County currently builds roads to widths as recommended by AASHTO without bicycle accomodations. Some city lane width standards exceed AASHTO guidelines.

During the public meetings, bicyclists were insistent about retaining rights to use all streets and not being prohibited from riding on any street. For this reason, the on-street plan includes recommendations for all street classifications.

Designated bicycle lanes and routes are most often proposed along collectors. In undeveloped and developing districts, arterials will be designated as bicycle routes until direct and continuous collectors are built. Although bicycling is not encouraged along heavily traveled arterials, design of lane widths, drainage grates and shoulders should consider bicyclists who will occasionally use these routes. Bicyclists do have to cross arterial streets and provisions for crossings should be provided for in intersection design.

Planning Recommendations and Design Standards

For each classification the following information and recommendations were developed:

- *Goals*
- *Route Characteristics*
- *Color coding of routes on Maps*
- *Planning Standards and Guidelines*
- *Implementation Strategies and Issues*
- *Management, Land Planning and Maintenance Considerations*

Section IV.- *Classifications* describes recommendations in greater detail.

National engineering standards and design guidelines were reviewed and those most appropriate to Montana included in this document as the Plan's recommendation to the County Surveyor's Office and The City Engineering Department.

Refer to *Section VI. - Design Standards* for immediate and long term detailed recommendations.

Route Recommendations

With assistance from the bicycling community, the planning team reviewed routes and formulated the recommendations included in this document.

On going refinement of the proposed routes and periodic updates of the plan to respond to changing needs and priorities will be required. As rural areas become urbanized,

bicycling needs will need to be re-evaluated and the most appropriate routes for designation determined. As funds become available, study routes by district and include maps for neighborhood connections.

On-Street Routes

All streets should be made more bicycle friendly. In developed areas Collectors and Minor Arterials are most appropriate for designated routes. Designated routes should be continuous with similar characteristics. Designation as a bicycle route will make routes safer. Inclusion of a lane will do more to encourage bicycle use.

In many existing situations, existing pavement width suggests the use of wide outside curb lanes will be most realistic. Denver has adopted this standard, using standard MUTCD symbols as pavement markings. This is an experimental program. In order for Billings to use this approach with formal approval by FHWA, an application should be made to FHWA. Denver has implemented the standard without formal approval.

Off-Street Routes

Off-street route classifications are based on use, user preferences, land characteristics, ownership, and status of access rights. Off-street corridors should be continuous and developed when use rights along significant lengths are acquired.

Potential corridors are identified on the ***BikeNet Off-Street Plan*** These corridors are mapped as conservation corridors or bike paths. High priority off-street projects with multiple use potential are identified as TRAC's (Transportation, Recreation, Access and Conservation) to reflect their potential for multiple uses.

Proposed TRAC's

Rimrock

Begins at Swords Park- Black Otter Trail and continues west to Sky Ranch Subdivision. Connects with potential Corridor north of Highway 3 along wetern edge of the Airport and a mountain bike / multiple use trail along Rims.

Yellowstone River South

Potential linkage south of the Yellowstone River from Lockwood to Duck Creek along county road right-of-way, public land, and various drainages, such as Blue Creek.

Alkali Creek

The proposed path begins at Yellowstone River/MetraPark. An underpass at Main Street, continues the path west through parkland along Alkali Creek.

Kiwanis/Heights Abandoned Rail

The corridor begins at Mary Street and connects to the Yellowstone River Greenway at Two Moon Park. Potential exists to extend this corridor further north to Five and Seven Mile Creeks.

Downtown/West End Rail

Beginning near the East Bridge, this corridor

follows the active rail tracks into Downtown and continues all the way west to the Homestead Business Park area.

BBWA Canal (Lower and Upper)

Potential Path follows BBWA Canal in the Heights and through the West End.

Shiloh/Zoo

An off-road path paralleling Shiloh Road along the west side will connect to greenway corridors proposed in the West End Storm Drainage Master Plan. This TRAC will also potentially connect to the Yellowstone River along Canyon Creek using an existing Canyon Creek underpass at Interstate 90.

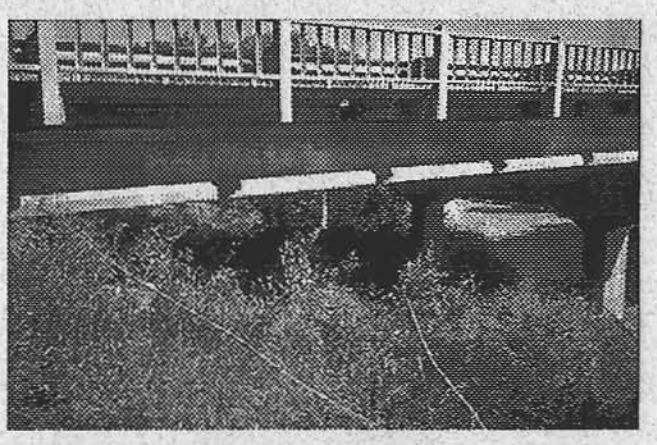
Yellowstone River Greenway

Proposed path links Two Moon, Big Sky Islands, and Coulson Parks, potentially continuing southwest to Riverfront Park, Duck Creek, and the County line and northeast to approximately Custer.

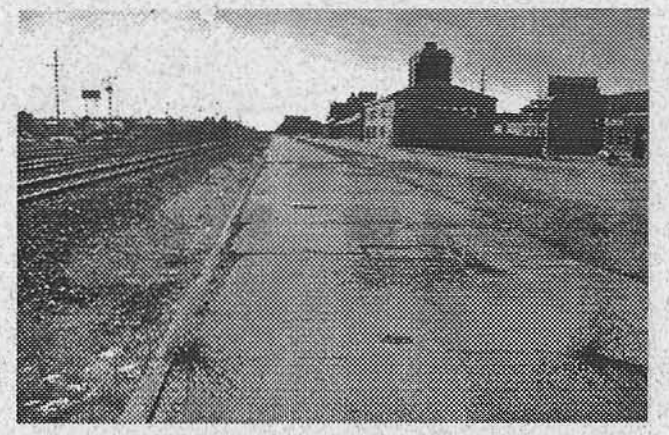
West End Greenway

Located in multi-use drainage corridors master-planned for the west end of Billings. Connects with Shiloh/Zoo Path.

It was not within the scope of the BikeNet Plan to identify short segments of neighborhood off street paths. Many of the identified corridors include multiple land owners and private lands. For this reason the many corridors have been deliberately portrayed as conservation corridors indicating general areas



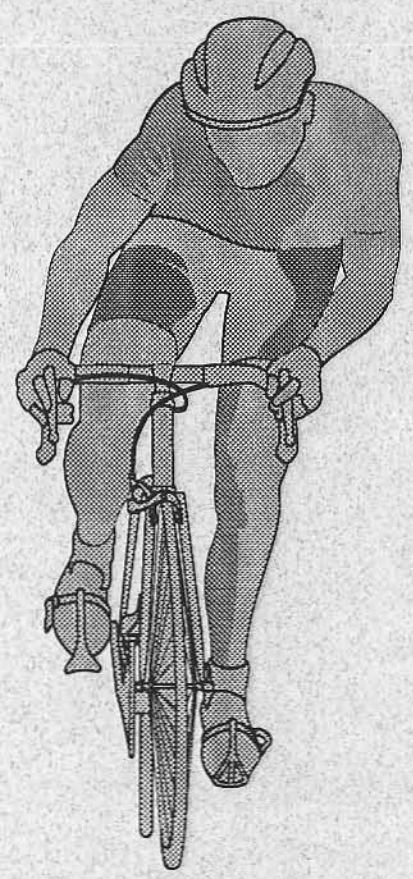
Existing Bridge At Canyon Creek Will Provide Future Underpass



Bike Path Along Active Rail Links Downtown To The River, Metra and Billings Heights

View of Two Moon Park From Path Connecting Mary Street To Alkali Creek

with importance as travel-ways. The intent in this Plan is to fully involve the land owners, public, and appropriate resource experts in determining the specifics of any improvements in or public use of these corridors.



Strategy

C1. IMPROVE BICYCLE FACILITIES THROUGH PLANNING, DESIGN AND IMPROVEMENT PROJECTS

Actions

C 1.1. Address bicycles and pedestrian transportation as an integral part of transportation planning

Address bicycles on all transportation plan and street design standard updates for rural, urban, city and county standards.

C1.2. Adopt planning and design guidelines and standards described in the following section of this document

Guidelines are provided for construction, operation, and maintenance of on-street and-off street bicycle facilities in rural and urban areas. Integrate these guidelines and standards into all appropriate decision making , funding, and regulatory processes.

C1.3. Involve the citizens in transportation project planning

Solicit input on location, design, and funding.

C1.4 Identify "quiet" and "slow" streets

As part of detailed neighborhood planning process, identify *"quiet and slow" streets*. Establish traffic planning programs and implement appropriate improvements to insure traffic speed and volume remain low on these streets while maintaining adequate neighborhood circulation and access.

C1.5. Adopt planning and design standards and route management strategies for both bicycles and vehicles for <u>all</u> road classifications.

Design streets recognizing bicyclists will ride on all streets. Detailed recommendations are documented in the following section of this plan.

C1.6. Implement a core system of <u>designated and signed</u> on street bicycle routes

Designated routes are recommended on a 1-1/2 to 2 mile grid. Highest priority routes are illustrated on the plan in red and orange. Additional streets can and should be added as use and demand increases.

C1.7. Adopt planning and design standards

Geometric design guidelines recommended by AASHTO and FHWA should serve as the basis for adopted standards. Alternative surfacing treatments should be adopted to allow construction of soft surface or paved pathways for off road facilities in developing areas. Adopted standards should be safe and flexible.

C1.8. Adopt the following bicycle facility classifications:

Conservation Corridors
Improved Paths TRAC's
Improved Trails
Neighborhood Paths
Arterial District Connectors
Primary District Connectors
Secondary District Connectors
Neighborhood Connectors, Quiet Street
Scenic Routes and Unimproved Roads

Refer to Classification section for detailed description.

C1.9. Preserve potential corridors for future use

Adopt a policy to preserve active rail, utility, and abandoned closed and proposed road right-of-ways and natural corridors for non-motorized use.

C1.10. Set a goal to complete a bicycle inventory and capital Improvement plan similar to the plan for city-wide curb, gutter, and sidewalk Improvements.

This inventory should extend into the county with an emphasis on providing safe school routes. Adopt a policy to consider bicycle needs prior to initiating construction of street, curb, gutter, and sidewalk improvements.

C1.11. Include priority bicycle projects in annual Transportation Improvement Plan (TIP)

As part of the local transportation planning process include bicycle and pedestrian components to the annual TIP.

Table 2
SUMMARY OF CURRENT STREET STANDARDS AND ALTERNATIVES
Alternatives for Retrofitting and Revising Street Standards to Improve Use By Bicycles
Revised 3/12/95

Width Shown in Feet	CURB	PARK	BIKE	LANE	LANE	MEDIAN or TURN	LANE	LANE	BIKE	PARK	CURB	PAVE WIDTH	NOTES
Urban Minor Arterial, 4 Lane + Median													
Current Billings Standard	2	0	0	12	12	16	12	12	0	0	2	68	
Retrofit Alternative Wide Ouside Shared Lanes	*2*	*0*	*0*	*14-15*	*10-11*	*14*	*10-11'*	*14-15*	*0*	*0*	*2*	*68*	
Retrofit- Add Bike Lanes	2	0	5	11	11	10	11	11	5	0	2	68	Requires Median removal
Current AASHTO Bike Standard w/ Local Str. Std.	2	0	5-6	12	12	16	12	12	5-6	0	2	78-80	Not Realistic
New Standard	2	0	0	15	11	14	11	15			2	*70*	Add 2' to Current Std.
Std. Urban Minor Arterial, 4 Lane, No Parking													
Current Billings Standard	2	0	0	12	12	0	12	12	0	0	2	52	
Retrofit Alternative Wide Ouside Shared Lanes	*2*	*0*	*0*	*14*	*10*	*0*	*10*	*14*	*0*	*0*	*2*	*52*	
Retrofit- Add Bike Lanes	*2*	*0*	*4*	*10*	*10*	*0*	*10*	*10*	*4*	*0*	*2*	*52*	
Retrofit- Reduce Travel Lanes, Add Turn Lane	2	0	5	12	0	12-14	0	12	5	0	2	*50-52*	Where Vol.s Permit
Current AASHTO Bike Standard w/ Local Str. Std.	2	0	5-6	12	12	0	12	12	5-6	0	2	64	Not Realistic
New Standard	2	0	0	15	11	0	11	15	0	0	2	*56*	Add 4' to Current Std.
New Standard 3-Lanes	2	0	5	12	0	12-14	0	12	5	0	2	*50-52*	Where Vols. Permit
Std. Urban Minor Arterial, 4 Lanes, Left Lane													
Current Billings Standard	2	0	0	12	12	12	12	12	0	0	2	*64*	
Retrofit Alternative Wide Ouside Shared Lanes	*2*	*0*	*0*	*15*	*10*	*10*	*10*	*15*	*0*	*0*	*2*	*64*	
Retrofit- Add Bike Lanes	*2*	*0*	*5*	*10*	*10*	*10*	*10*	*10*	*5*	*0*	*2*	*64*	
Current AASHTO Bike Standard w/ Local Str. Std.	2	5-6	0	12	12	12	12	12	5-6	0	2	*74-76*	Not Realistic
New Standard	2	0	0	15	11	11	11	15	0	0	2	67	Add 3' to Current Std.
Minor Arterial, 2 Lanes, with Parking													
Current Billings Standard	2	10	0	14	0	0	0	14	0	10	2	*52*	
Retrofit Alternative Wide Ouside Shared Lanes	*0.5*	*8.5-9.5*	*0*	*15-16*	*0*	*0*	*0*	*15-16*	*0*	*8.5-9.5*	*0.5*	*48-52*	
Retrofit Alternative-Add Bike Lanes	*0.5*	*8.5*	*5*	*12*	*0*	*0*	*0*	*12*	*5*	*8.5*	*0.5*	*52*	
Current AASHTO Bike Standard w/ Local Str. Std.	2	10	5-6	14	0	0	0	14	5-6	10	2	*62-64*	Not Realistic
New Standard	*0.5*	*8.5-9.5*	*0*	*15-16*	*0*	*0*	*0*	*15-16*	*0*	*8.5-9.5*	*0.5*	*48-52*	
Standard Urban 2 Lane Collector w/ parking													
Current Billings Standard	0.5	10	0	14	0	0	0	14	0	10	0.5	49	
Retrofit Alternative Wide Ouside Shared Lanes	*0.5*	*9*	*0*	*15*	*0*	*0*	*0*	*15*	*0*	*9*	*0.5*	*49*	
Retrofit Alternative- Add Bike Lanes	*0.5*	*8*	*5*	*11*	*0*	*0*	*0*	*11*	*5*	*8*	*0.5*	*49*	
Retrofit-Bike Lanes - Remove Parking 1Side	0.5	8.5	5	11-14				11-14	5	0	2	43-49	
Current AASHTO Bike Standard w/ Local Str. Std.	0.5	10	5-6	14	0	0	0	14	5-6	10	0.5	59-61	Not Realistic
New Standard	0.5	9	0	15	0	0	0	15	0	9	0.5	49	
Standard Urban 4 Lane Collector No Parking													
Current Billings Standard	0.5	0	0	12	12	0	0	12	12	0	0.5	49	
Retrofit Alternative Wide Ouside Shared Lanes	2	0	0	12.5	10	0	10	12.5	0	0	2	49	
Alt. Std. Revise- Add Bike Lanes	*0.5*	*0*	*6*	*11-12*	*0*	*11-13*	*0*	*11-12*	*6*	*0*	*0.5*	*49*	
Current AASHTO Bike Standard w/ Local Str. Std.	0.5	0	6	12	12	0	12	12	6	0	0.5	61	Not Realistic
New Standard	2	0	0	15	11	0	11	15	0	0	2	56	
New 3 Lane Std.	2	0	5	12	0	11	0	12	5	0	2	49	Recommended if Volumes Permit

Table 2

SUMMARY OF CURRENT STREET STANDARDS AND ALTERNATIVES

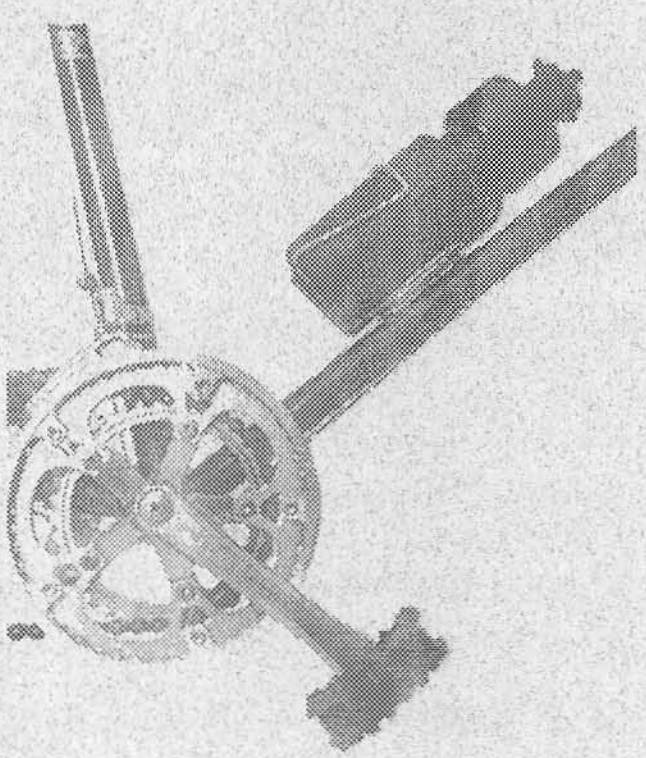
Alternatives for Retrofitting and Revising Street Standards to Improve Use By Bicycles

Revised 3/14/95

Width Shown in Feet	CURB	PARK	BIKE	LANE	LANE	MEDIAN or TURN	LANE	LANE	BIKE	PARK	CURB	PAVE WIDTH	NOTES
Std. Urban Local Access- Residential													
Current Billings Standard	0.5	8	0	10	0	0	0	10	0	8	0.5	37	
Retrofit Alternative Wide Ouside Shared Lanes	*0.5*	*7.5*	*0*	*14*	*0*	*0*	*0*	*13*	*0*	*0*	*2*	*37*	*High Vols., Remove Park 1 Side*
Alt. Standard- Reduce Width to Calm traffic	2	0	0	12-14	0	0	0	12-14	0	0	2	28-32	
Current AASHTO Bike Standard w/ Local Str. Std.	0.5	8	5	10	0	0	0	10	5	8	0.5	47	Not Realistic
NewStandard	0.5	8	0	10	0	0	0	10	0	8	0.5	37	
New Standard	0.5	8	0	14	0	0	0	14	0	0	2	38.5	High Vols'
New Standard	2	0	0	15	0	0	0	15	0	0	2	34	W/O Parking
Std. Urban Local Access Commercial													
Current Billings Standard	0.5	10	0	14	0	0	0	14	0	10	0.5	49	
Retrofit Alternative Wide Ouside Shared Lanes	*0.5*	*9*	*0*	*15*	*0*	*0*	*0*	*15*	*0*	*9*	*0.5*	*49*	
Alt. Std. Retrofit- Add Bike Lanes	0.5	8	5	11	0	0	0	11	5	8	0.5	49	*Only Req'd w/ volumes > 2000 ADT
Current AASHTO Bike Standard w/ Local Str. Std.	0.5	9.5	5	12	0	0	0	12	5	9.5	0.5	54	Not Realistic
New Standard	0.5	9	0	15	0	0	0	15	0	9	0.5	49	
Standard Rural 2 Lane No Parking													
Current County Standard	0	0	0	12	0	0	0	12	0	0	0	24	
Retrofit Alternative Wide Ouside Shared Lanes	*0*	*0*	*0*	*14-15*	*0*	*0*	*0*	*14-15*	*0*	*0*	*0*	*28-30*	
Alt. Std. Revise- Add Paved Shoulder	*0*	*0*	*4*	*12*	*0*	*0*	*0*	*12*	*4*	*0*	*0*	*32*	
Alt. Std. Revise- Add Bike Lanes	0	0	5	12	0	0	0	12	5	0	0	34	
Current AASHTO Bike Standard w/ Local Str. Std.	0	0	5-6	12	0	0	0	12	5-6	0	0	34-36	Rec. Bike lane width varies w. Volumes
Std. Rural Local Access													
Current County Standard	0	0	0	12	0	0	0	12	0	0	0	24	
Retrofit Alternative Wide Ouside Shared Lanes	0	0	0	14-15	0	0	0	14-15	0	0	0	28-30	
Alt. Std. Revise- Add Paved Shoulder	0	0	4	12	0	0	0	12	4	0	0	32	
Current AASHTO Bike Standard w/ Local Str. Std.	0	0	5-6	12	0	0	0	12	5-6	0	0	34-36	Rec. Bike lane width varies w. Volumes
New Standard- Shared, Low Volumes	0	0	0	12	0	0	0	12	0	0	0	24	Less than 500 ADT
New Standard- Rds w/o walks or w higher vols.	0	0	4	12	0	0	0	12	4	0	0	32	

NOTE: ITALIC INDICATES RECOMMENDATION- REFER TO SKETCHES

IV. ROUTE CLASSIFICATIONS



This section describes bicycle considerations for the proposed classifications of bicycle routes. This section is intended to provide guidance to public and private transportation engineers as the On and Off Street Bicycle network is developed and upgraded as part of the community transportation system.

Arterial District Connectors

Goals - *Arterial District Connectors*

Recognizing bicyclists will use all roads, these routes will be managed to accommodate, but not encourage bicycle use. Where an alternate primary or secondary district connector route is not available, these routes may be part of the designated system. Use of arterials as bicycle routes will be most common in rural or developing areas. Bicycling improvements will be constructed with the goal of maintaining vehicle capacity and levels of service proposed in the transportation plan.

Route Characteristics - *Arterial District Connectors*

Arterial District Connectors provide the most direct connections between districts. Classified as Principal Arterials in the *Billings Urban Transportation Plan*, these urban and rural routes are projected to carry the highest volumes of traffic per district at the highest speeds.

Vehicles include trucks and autos as well as buses in urban areas and farm vehicles in rural areas.

Cyclists using arterial connector routes are generally more advanced in ability, and more concerned with efficiency and continuity than environmental quality.

The Map - *Yellow/Orange*

Existing and proposed arterial vehicle routes are designated with yellow and orange lines. Orange indicates routes where bicycle travel exists or is anticipated because an alternate route is not planned or completed. In some instances (Rimrock Road is an example) development patterns force bicyclists to use these routes. Examples of Orange routes include Wicks Lane, Shiloh Road, North 27th, South Billings Boulevard and Lockwood Frontage Road. Yellow indicates arterial routes where bicycling is not encouraged because an alternate parallel bicycle route exists. Examples include Main Street, Grand Avenue, South 27th, and State Avenue.

Planning Standards - *Arterial District Connectors*

Designed to allow for parallel travel of bicycles and vehicles in wide outside curb lanes in urban areas and on paved shoulders in rural areas.

Bicycle accommodations should occur within standard pavement widths in urban areas with lane striping modified to include a wide curb lane where space permits.

In rural areas, paved shoulders a minimum

3' to a maximum of 6' are recommended when traffic volumes exceed 2000 trips per day.

Designation of arterials as bicycle routes is recommended only along orange routes where no alternative routes are available and the level of bicycle use is significant. These routes will be most common in rural and developing areas.

Bicycle pavement markings along arterial streets not designated as District Connectors will be minimal and required only to ensure safety of motorists and bicyclists. Pavement marking along designated Arterial District Connector routes will be consistent with signing and marking of Primary District Connectors.

Planning Guidelines - *Arterial District Connectors*

1. Direct routes without uncontrolled street intersections and no on street parking.
2. No stops except at controlled intersections.
3. District Connector bicycle routes should cross arterials streets at signalized or controlled intersections.
4. Prohibit on street parking and minimize the number of approaches and curb cuts along arterials to improve safety for vehicles, bicycles, and pedestrians.

Implementation Strategies and Issues - *Arterial District Connectors*

Strategies

Along existing urban routes of sufficient width, wide curb lanes will help maintain desired vehicle level-of-service while still safely accommodating bicycles.

Rural Road standards should include a paved shoulder, a minimum of 4' in width.

Bicycle improvements should be addressed with road reconstruction, resurfacing or safety improvement projects.

Issues

The indirect configuration of collector streets proposed in the transportation plan for the area west of Shiloh may force bicycle travel onto arterial streets unless direct Primary or Secondary District Connector Routes are developed.

Retrofitting bike lanes into existing streets, with narrower than standard pavement widths may require restriping, lane narrowing or removal of parking.

Street widening is recommended only when the number of required vehicle lanes and safe bicycle accommodations cannot be provided without deviating from recommended standards for lane widths and a reasonable alternative route cannot be developed.

Management, Planning and Maintenance Policies - *Arterial District Connectors*

Management

When transportation improvements are planned for vehicles, commensurate bicycle planning should occur with the goal of maintaining or improving the safety of bicyclists. Planning considerations may include developing acceptable alternate routes.

The existing capacity and level of service for vehicles documented in *The 1990 Transportation Plan* will be maintained.

Alternatives to single-occupancy vehicles should be promoted and encouraged along all urban routes.

Vehicular traffic should be encouraged to use arterial routes rather than parallel District Connector routes. Bicycle traffic will be encouraged to use Primary District Connectors (Red) or Secondary District Connectors (Purple).

Land Planning Considerations

To minimize the need for bicyclists to use arterial routes, land use and transportation plans should (1) provide alternate on lower volume streets routes directly linking community districts, (2) provide on- or off-street links between subdivisions and neighborhoods.

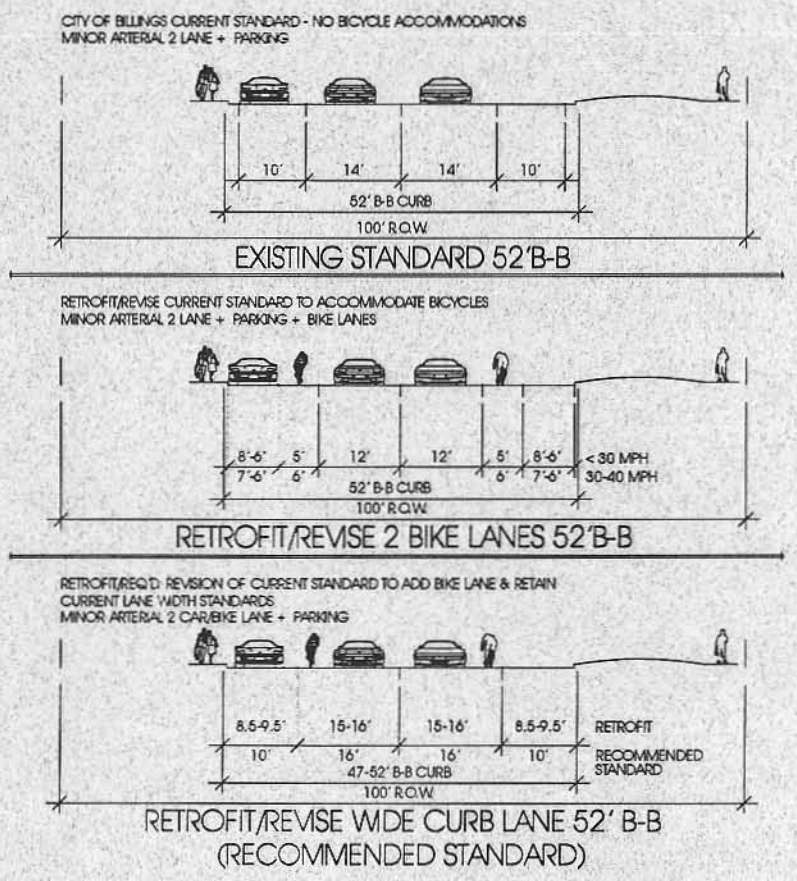
Maintenance

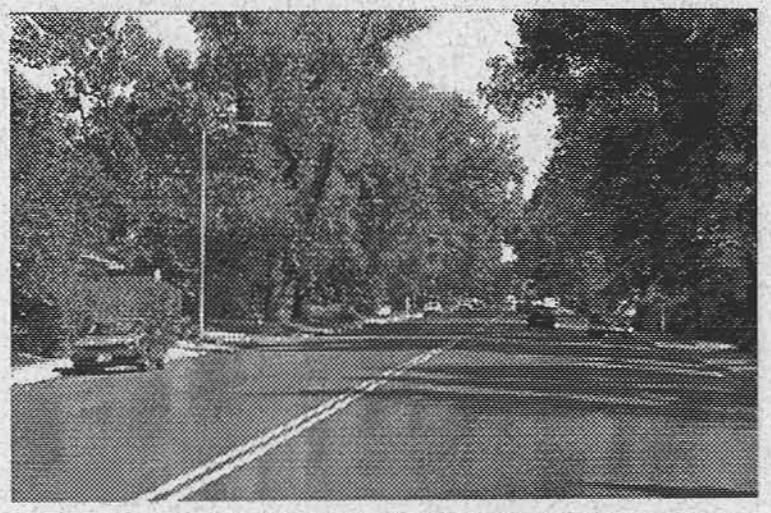
The lack of snow and debris along curbs or shoulders will encourage bicycles to stay right in the driving lane.

Roads should be maintained using standard municipal practices.

The sweeping action of vehicles will help keep shared lanes clean.

Minor Arterial 2 Lanes and Parking

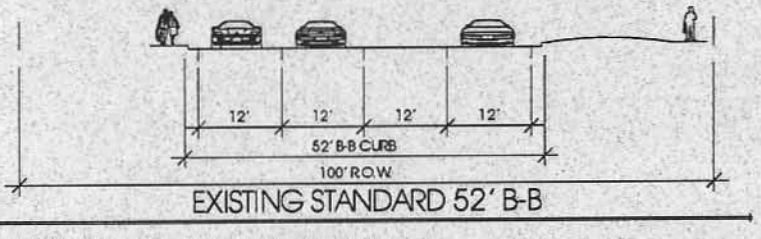




Poly Drive Could Easily Retrofitted To Include Bicycle Lanes

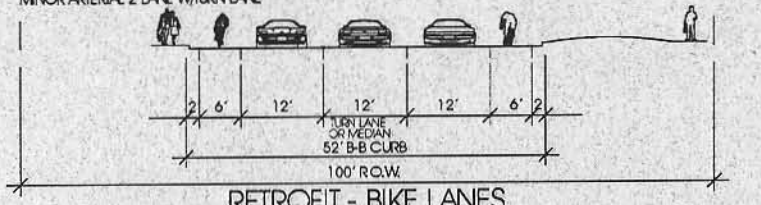
Minor Arterial
4 Lanes
No Parking

CITY OF BILLINGS CURRENT STANDARD NO BICYCLE ACCOMMODATION
MINOR ARTERIAL 4 LANE NO PARKING



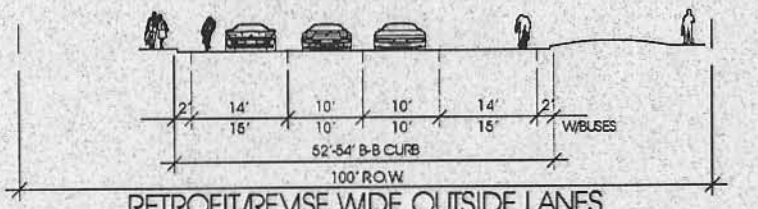
EXISTING STANDARD 52' B-B

RETROFIT STANDARD PROVIDE 2 BIKE LANES 52' B-B CURB
REDUCE # TRAVEL LANES, ADD TURN LANE
MINOR ARTERIAL 2 LANE W/TURN LANE



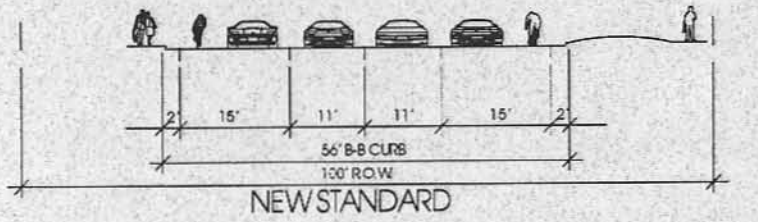
RETROFIT - BIKE LANES

RETROFIT WIDE CURB LANES APPROPRIATE FOR A CYCLIST
MINOR ARTERIAL 4 LANE NO PARKING



RETROFIT/REVISE WIDE OUTSIDE LANES

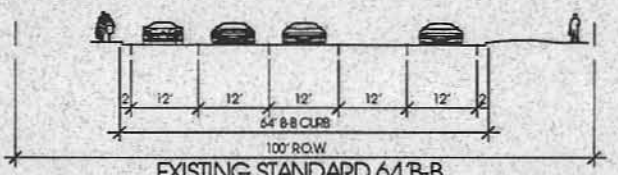
REVISE STANDARD PROVIDE WIDE CURB LANES 56' B-B CURB
MINOR ARTERIAL 4 LANE NO PARKING



NEW STANDARD

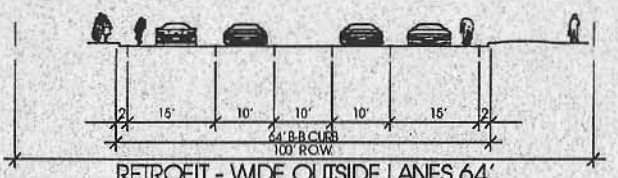
Minor Arterial 4 Lanes and Left Lane

CITY OF BILLINGS CURRENT STANDARD NO BICYCLE ACCOMMODATION
MINOR ARTERIAL 4 LANE - LEFT LANE



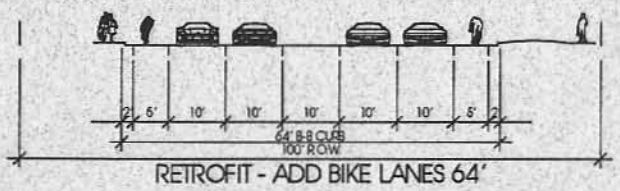
EXISTING STANDARD 64'B-B

REVISE STANDARD WIDE CURB LANE 64' B-B
MINOR ARTERIAL 4 LANE - LEFT LANE + WIDE CURB LANE



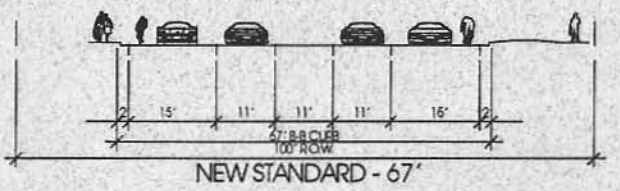
RETROFIT - WIDE OUTSIDE LANES 64'

REVISE STANDARD ADD BIKE LANES
MINOR ARTERIAL 4 LANE + LEFT LANE + 2 BIKE LANES



RETROFIT - ADD BIKE LANES 64'

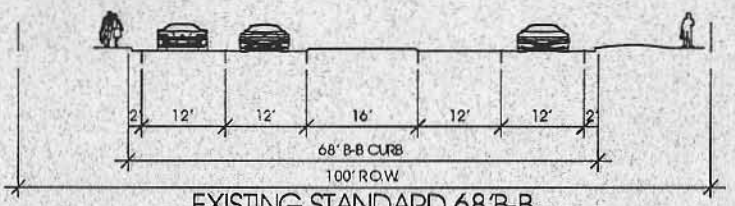
NEW STANDARD
MINOR ARTERIAL 4 LANE - LEFT LANE + WIDE CURB LANE



NEW STANDARD - 67'

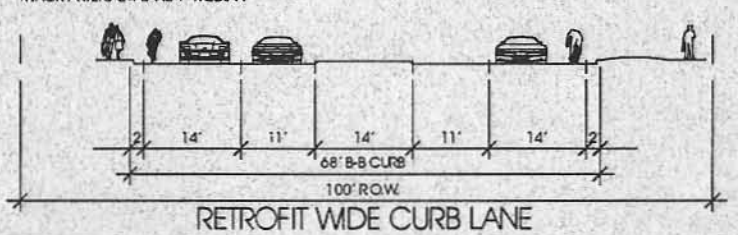
Minor Arterial 4 Lanes and Median

CITY OF BILLINGS CURRENT STANDARD NO BICYCLE ACCOMMODATION
MINOR ARTERIAL 4 LANE + MEDIAN



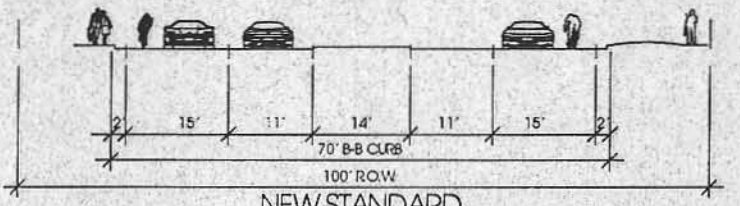
EXISTING STANDARD 68'B-B

RETROFIT WIDE CURB LANE
MINOR ARTERIAL 4 LANE + MEDIAN



RETROFIT WIDE CURB LANE

NEW STANDARD WIDE CURB LANE
MINOR ARTERIAL 4 LANE + MEDIAN



NEW STANDARD

Primary and Secondary District Connectors

Goals

Primary and Secondary District Connector routes will be developed and managed as bicycle routes to encourage and legitimize equal and shared use of these roads by bicyclists and vehicles. Bicycling will be accommodated in shared vehicle/auto lanes on low volume streets and on designated parallel bicycle lanes or wide outside lanes on streets with higher traffic volumes. These routes will be the basis of an on street network.

Route Characteristics - *Primary District Connector*

These routes provide direct, continuous connections between districts following streets classified in the *Billings Transportation Plan* as minor arterials and city/urban or county/rural collectors. Primary District Connectors should connect to off-street routes. Primary District Connectors will not require use of off-street routes to travel between districts. Secondary District Connectors may include short sections of off-road paths.

Vehicle traffic volumes along Primary District Connectors vary from one district to another. In most urban and rural districts a higher volume parallel arterial route has been identified in the Transportation Plan. Vehicle use includes trucks, autos buses, and farm vehicles.

Bicyclists using Primary District Connectors will include children, basic and advanced cyclists whose selection of a route gives equal consideration to directness, traffic volumes, and environmental quality.

Route Characteristics - *Secondary District Connector*

These routes generally occur on streets classified as residential or commercial. Secondary Connector Routes are shorter in length and may include short sections of off-road paths through schools, parks, or public lands. These routes are most common in developed urban areas. Secondary Routes provide less direct connections between districts, are along roads with lower traffic volumes, and link neighborhood residential areas to parks, schools, and neighborhood commercial uses. Secondary District Connectors generally provide more scenic and safer routes, particularly for children. Off road sections of paths developed to accommodate bicyclists and pedestrians should be a minimum of 7' in width.

The Map - *Red/Purple*

A proposed network of Primary District Connectors, located on a 1:1.5-mile grid is mapped in red. (Examples of red routes include Poly Drive, Lake Elmo, Senators, and Lewis Avenue.)

Secondary Connector Routes are mapped in purple. (Examples of Purple routes include Avenue C, Rolling Hills, and Shamrock.)

Planning Standards and Guidelines -

District Connectors

Standards

Designation of a grid planning District Connector Routes on a 1:1.5-mile grid in urban areas is proposed. Spacing of routes in rural and developing areas may initially be greater but these should relate to *The Transportation Plan* and accommodate present use and projected demand.

Primary or Secondary Connector Routes with traffic volumes exceeding 2000 vehicle trips per day will be designed to provide space for parallel travel of vehicles and bicycles. On urban sections, a separate 4' to 6' bicycle lane is needed, and on rural sections a paved 4' to 6' shoulder is recommended. Urban bicycle lanes will be developed within standard pavement widths through reallocation of pavement width with lower priority given to on-street parking. Lane width standards documented in *The Transportation Plan* will be modified to accommodate bicycles.

Primary routes will be identified in the Plan and on maps and with actual pavement markings in the street. Connections to on- and off-street routes will be identified with minimal route and directional signage.

Pavement markings in Billings will be MUTCD Symbols stenciled in wide outside lanes or standards bicycle lane markings determined most appropriate by the City Traffic Engineer. The available pavement width will influence the design. The stencil system currently in use in Denver is experimental. By applying to AASHTO for a research project Billings could use this same system. This system will work best for retrofitting existing streets as designated bicycle routes.

Guidelines

Provide direct and pleasant travel routes between districts with minimum stops. Designation and marking of a 1:1.5-mile grid for District Connector Routes is recommended. Desirable characteristics include:

1. Limited on-street parking
2. Minimize the number of commercial drive approaches.
3. Arterial street crossings will occur in order of preference, at underpasses or signalized intersections in urban areas, and controlled intersections or school route crossings in rural areas.
4. With the exception of signalized intersections on arterial routes, all intersections should yield the right-of-way to District Connector Routes.
5. Street tree planting and preservation should be required on all construction projects and encouraged through ordinances and city tree planting programs to improve the environmental quality along these routes.
6. Further improvement or protection of environmental quality of these routes should be encouraged through landscape and sign control ordinances implemented through the building permit application process.
7. Traffic calming may be required to encourage vehicles to travel at posted speed limits. Where appropriate, posted speed limits will be signed in 5 MPH increments.

Implementation Strategies and Issues - *District Connectors*

Strategies

Bicycle improvements along District Connector Routes may warrant independent bicycle system improvement projects. Additional improvements, accomplished through street reconstruction and resurfacing projects and permitted improvements to lands adjacent to theses routes, will complete the system.

Implementing a network of District Connector Routes is the highest priority for the on-street system(mapped in red on Off-Road Master Plan).

Retrofitting bicycle lanes into adopted standard urban street pavement widths will be accomplished through re-striping traffic lanes and/or removal of on-street parking.

Rural standards should be adopted to include additional shoulder width along District Connector Routes.

Street widening of urban routes is recommended only when the number of needed vehicle and bicycle travel lanes cannot be accommodated by modifying the existing lane widths to conform to minimum AASHTO standards.

Removing parking is encouraged in lieu of street widening. When off-street parking is inadequate or impractical to build, a special public review of alternative proposals should occur. The proposed alternatives would be reviewed based on impacts on the bicycling environment as well conformance with BikeNet, the Comprehensive Plan, and zoning and building codes.

Street trees removed or damaged by street projects along these routes should be replanted as part of the street improvement contract.

Issues

Retrofitting bike lanes on existing streets with narrower than standard pavement widths may require re-striping, and/ or lane narrowing, removal of on street parking, or speed limit reductions.

Future collectors proposed in *The Transportation Plan* do not provide direct connections between districts. Gaps in the BikeNet system should be avoided by developing secondary on- or off-street connections.

Management, Land Planning and Maintenance Considerations - *District Connectors*

Management

Management strategies for these routes will include encouraging shared use by bicycles and vehicles and improving the level of service provided for bicycles. Vehicular traffic increases will be directed to parallel arterial routes.

When transportation improvements are planned for vehicles, commensurate planning will occur for bicycles. The goal here is to provide an equal level of service for both vehicles and bicycles. In no instance should the current level of service for bicycles be reduced along these routes. Secondary routes should be managed to retain lower traffic volumes. Shared use of the travel lane by bicycles and vehicles should be encouraged and accommodated.

Planning

To encourage shared use by bicycles and vehicles, land use and transportation plans should direct increases in vehicle traffic to parallel arterial routes.

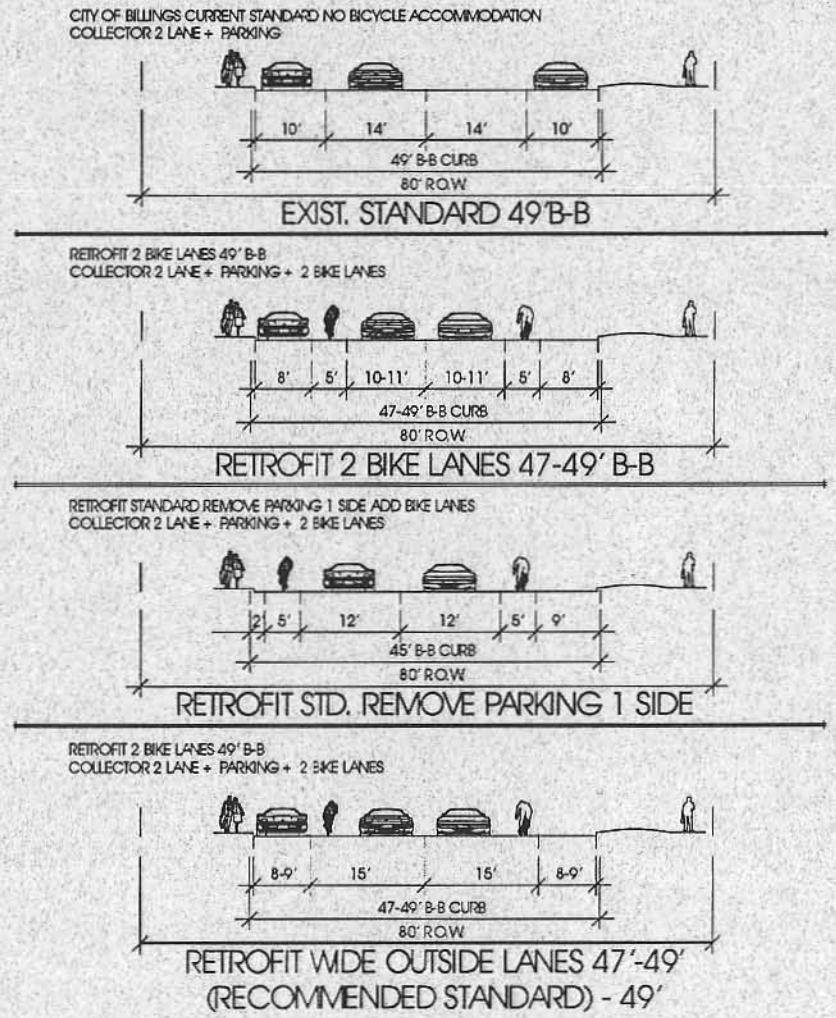
Minimizing approaches and curb cuts will improve safety for bicycles and pedestrians

Avoid gaps in the BikeNet system or the use of circuitous bicycle routes which will cause bicyclists to select principal vehicle arterials as routes.

Maintenance

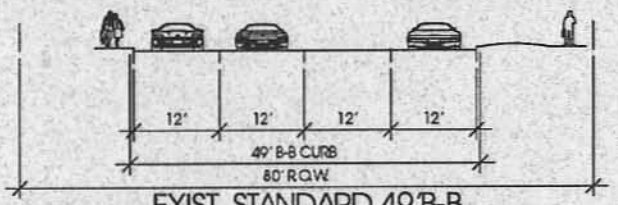
Lanes should be kept clean to encourage bicycles to stay right. Maintenance should occur as standard road maintenance. Slightly more frequent sweeping and maintenance of these routes is recommended. Off-street segments will require special maintenance considerations depending on length, location, and accessibility. Lack of consistent maintenance, including snow removal, is the reason advanced and commuting cyclists prefer continuous on-street routes.

Collector 2 Lanes and Parking



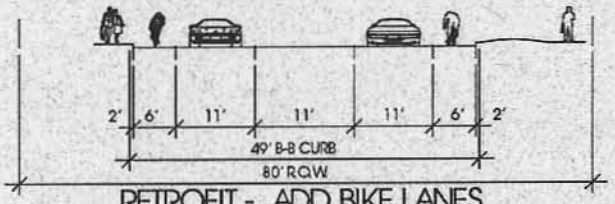
Collector
4 Lane
No Parking

CITY OF BILLINGS CURRENT STANDARD NO BICYCLE ACCOMMODATION
COLLECTOR 4 LANE NO PARKING



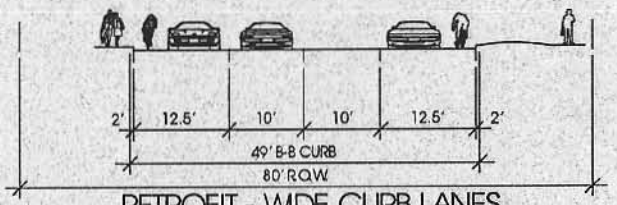
EXIST. STANDARD 49'B-B

RETROFIT ADD 2 BIKE LANES, REDUCE TRAVEL LANES
COLLECTOR 4 LANE NO PARKING



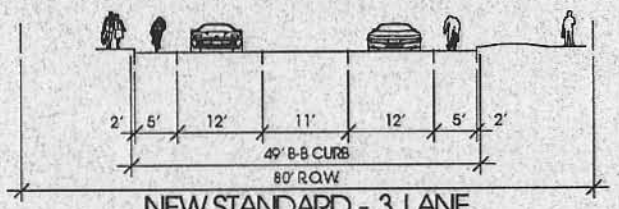
RETROFIT - ADD BIKE LANES

CITY OF BILLINGS CURRENT STANDARD NO BICYCLE ACCOMMODATION
COLLECTOR 4 LANE NO PARKING



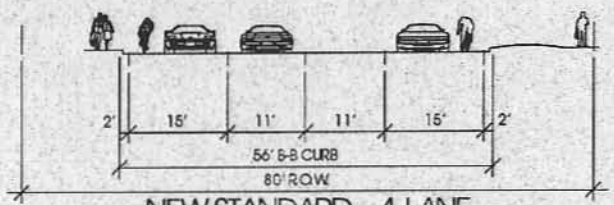
RETROFIT - WIDE CURB LANES

NEW STANDARD - 3 LANE
COLLECTOR 4 LANE NO PARKING



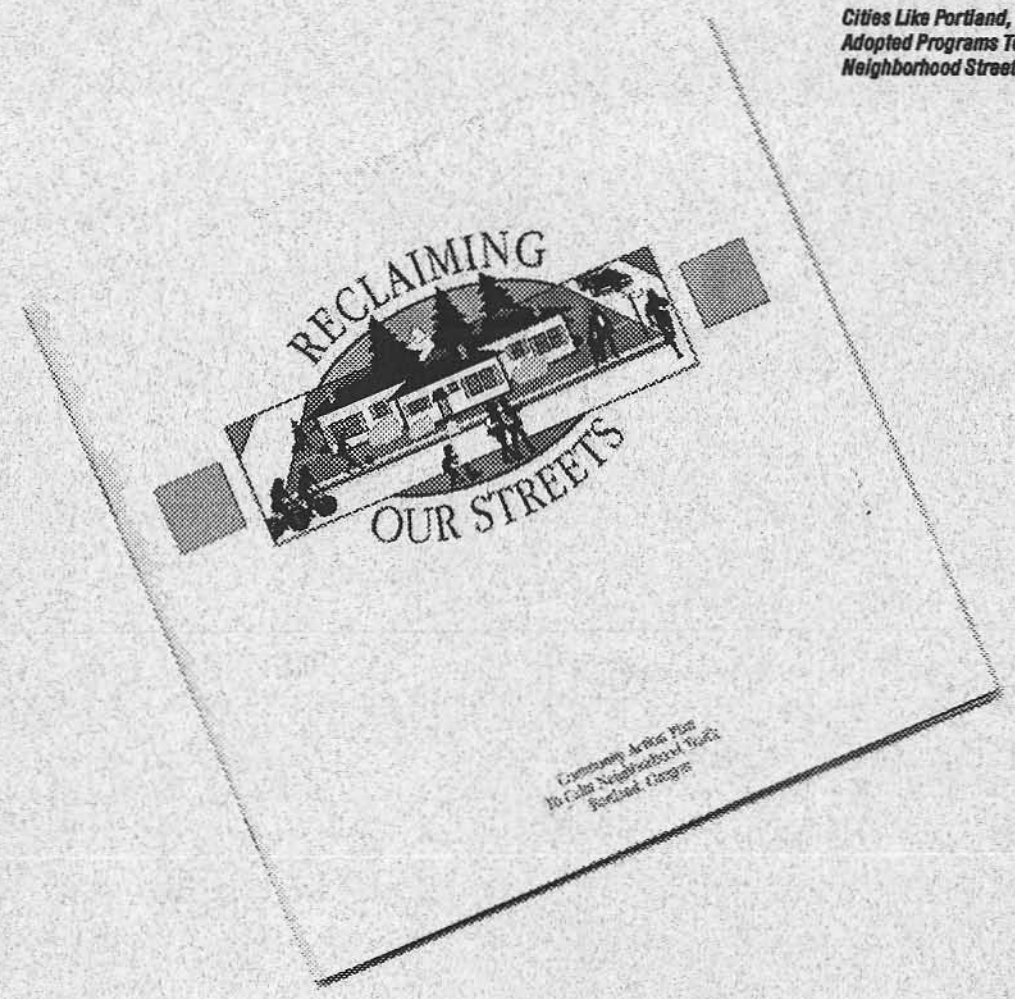
NEW STANDARD - 3 LANE

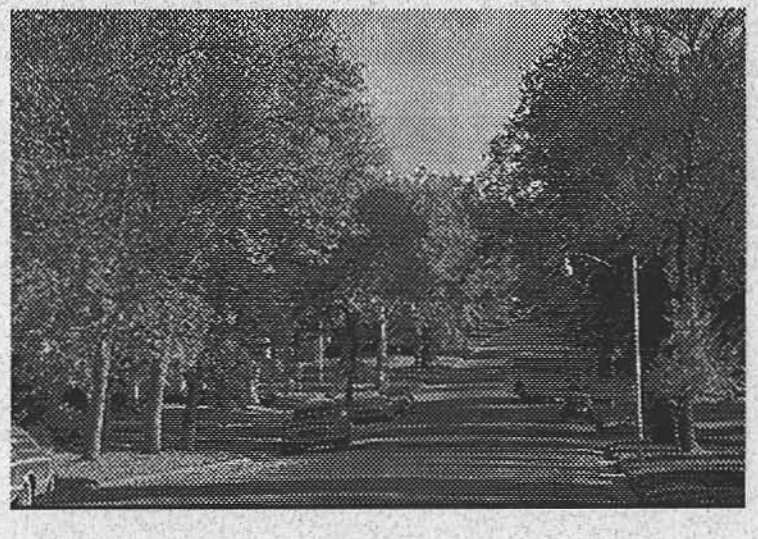
NEW STANDARD - 4 LANE
COLLECTOR 4 LANE NO PARKING



NEW STANDARD - 4 LANE

Cities Like Portland, Oregon Have Adopted Programs To Reduce Traffic On Neighborhood Streets





Neighborhood Connectors

Goal

A network of neighborhood connectors should be identified and developed with the neighborhoods participating in the planning. This network would provide safe connections for children traveling between subdivisions and to neighborhood activity centers. To accommodate shared use of these streets by vehicles, bicycles, and pedestrians, traffic management strategies should focus on preserving or enhancing the quality of the streetscape and employing traffic calming designs in the streets to maintain low traffic volumes and slow speeds.

Characteristics - *Neighborhood Connectors*

Neighborhood Connector Routes may combine on- and off-street segments to connect residential subdivisions to neighborhood amenities.

Routes predominantly follow neighborhood streets with low traffic volumes. Short off-street sections may occur following TRAC's, neighborhood paths, sidewalks, open space, and utility corridors. Although separated bicycle and pedestrian paths are preferred, off-street sections may occasionally be wide sidewalks shared with pedestrians.

Neighborhood Connector Routes should provide opportunities to connect to District Connectors and Regional TRAC's (Paths), and Trails.

Bicyclists will be children and basic cyclists whose selection of a route considers safety and environmental quality above efficiency.

Vehicle traffic volumes are low including autos, small delivery vehicles, and service trucks.

The Map - *Not Shown*

Neighborhood Connector Routes were reviewed during the study, but the scale of the maps and the need for greater involvement of neighborhood residents in planning route locations precludes detailed mapping of these connectors. A program for involving neighborhoods in decision making regarding bikeways improvements, efficiency, speed limits and controls, and traffic calming improvements should be developed by the City Traffic Engineer. Examples of similar programs instituted in Colorado, Washington, and other areas are included in the Project Notebook part of this Plan. FHWA Publication PD-93-028, Case Study 19, "Traffic *Calming, Auto Restricted Zones and Other Traffic Management Techniques-Their Effects on Bicycle and Pedestrians*, is useful and should be referred to when a program is developed.

Planning Standards and Guidelines - *Neighborhood Connectors*

<u>Standards</u>

Routes will be managed to encourage shared lane use by bicycles and vehicles on narrow, tree-lined, neighborhood streets. Street

and intersection design standards should be expanded to include appropriate traffic calming techniques.

Bicycle accommodations will occur within adopted standard street pavement widths by managing traffic to maintain low volumes and slow speeds. If low volumes and speeds cannot be maintained, bicycle lanes will need to be added within existing pavement widths. This can be done by reducing lane widths, re-striping, and/or removal of on-street parking.

Street widening of neighborhood routes is not recommended and should be permitted only when the number of required, shared, vehicle/ bicycle lanes cannot be accommodated within the minimum street widths recommended by AASHTO.

Street tree planting and preservation should be required as part of all transportation improvement projects along neighborhood routes.

Guidelines

At-grade crossing of arterials will be discouraged. When needed they will occur in order of preference, at grade separated crossings, signalized intersections, signed intersections, or school route crossings.

Tree planting/ preservation, environmental enhancements, and other appropriate traffic calming devices will be encouraged

Intersections of Neighborhood Routes with arterial and collector streets will be controlled, yielding right-of-way to more heavily traveled roads. Arterial and collector street crossings will be striped and signed.

Neighborhood Routes will be compatible with school routes, crossings, and signal locations.

Neighborhood Routes should interface with bus routes.

Minimizing traffic volume, speed, and on-street parking through physical design will improve safety for bicycles and pedestrians.

Implementation Issues and Strategies - *Neighborhood Connectors*

Strategies

Neighborhood Routes should be identified and mapped with the public and school district participation. Detailed neighborhood planning and traffic studies should be conducted with appropriate public education, participation, and review of the processes prior to final route designations.

Issues

Coordinate with the City Public Utilities Department, private utility companies, and irrigation and drainage ditch companies during the subdivision development process to provide linkages between all community neighborhoods and subdivisions via low volume streets or neighborhood paths.

Narrower road section standards, traffic calming, and removing or reducing on- street parking along these Neighborhood Routes should be encouraged to improve safety.

Traffic calming improvements, including street width neck downs, cul de sacs, turn arounds, and narrower pavement widths, will require alternative street design standards.

Management, Land Planning And Maintenance Considerations - *Neighborhood Connectors*

Management

Strategies for these Neighborhood Routes will include preserving lower and slow traffic volumes to encourage safe, shared, use of travel lanes by both bicycles and vehicles. The route management strategies should be developed with neighborhood involvement. Planning should consider all of the potential increments and values involved (i.e., children playing, streetscape quality, tree preservation, pedestrian use) rather than just the single purpose of efficiently accommodating all vehicular traffic increases. Vehicular traffic increases on Neighborhood Streets should be directed to other routes. Improvements to keep vehicles traveling at or below posted speeds should be made.

When street improvements are planned, evaluate their impact on resulting traffic volumes and speed as well as bicycle friendliness. In no instance should the current level of service for bicycles be reduced along these routes. Increases in traffic volumes and consensus among neighborhood residents should trigger traffic calming improvements. Street Improvement proposals will be reviewed based on impacts to bicycling, as well as conformance with BikeNet, design standards, and the Comprehensive Plan.

Planning

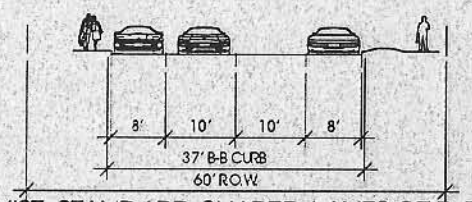
To encourage shared use by bicycles and vehicles, land use and transportation plans should include design proposals to maintain low traffic volumes or require mitigation of increases in volumes. Interconnections between all residential subdivisions should be provided to reduce the need for children to make neighborhood interconnections on the more heavily traveled District Connector bicycle routes.

Maintenance

Maintenance will occur as standard road maintenance. Lacking a comprehensive City wide program. Lacking a comprehensive program, maintenance of short sections of off-street neighborhood paths should be handled like sidewalks presently are in the city; holding landowners responsible.

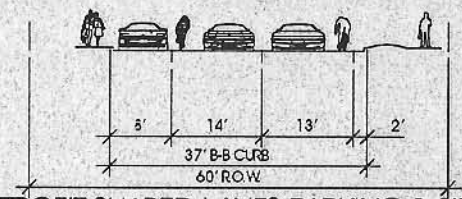
Local Access Residential

CITY OF BILLINGS CURRENT STANDARD NO BICYCLE ACCOMMODATION
LOCAL ACCESS RESIDENTIAL



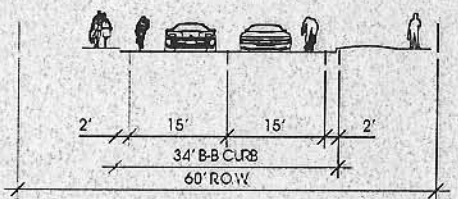
EXIST. STANDARD SHARED LANES 37 B-B

RETROFIT SHARED LANES PARKING 1 SIDE
LOCAL ACCESS RESIDENTIAL



RETROFIT SHARED LANES PARKING 1 SIDE

REVISE STANDARD SHARED LANES W/O PARKING
LOCAL ACCESS RESIDENTIAL



REVISE STD. SHARED LANES W/O PARKING

Conservation Corridors

Goal

Conservation corridors are identified with the goal of preserving these corridors as a public amenity for future transportation, recreation, and conservation of regionally significant natural, cultural, and scenic resources. Identified regional corridors include the Yellowstone River, perennial creeks, flood plains, areas of scenic interest, and corridors of historical, cultural, and transportation value.

Although not mapped, neighborhood paths along drainages and irrigation ditches as well as utility corridors planned to link neighborhoods are also included.

Characteristics - *Conservation Corridors*

Identified Conservation Corridors have potential to connect several districts, accommodate multiple uses, and provide multiple community benefits.

Proposed Conservation Corridors parallel and/or include corridors of natural, scenic, cultural, or resource management value. Corridors will be managed for multiple benefits with a future network of paths or trails evolving to meet needs of users.

Ideally all corridors will be linked and eventually include attractive off-road, looped, and connected bicycle routes. Future uses of the corridors may include:

- Transportation and recreation; bicycling by people of all ages and abilities; trails for running, skiing, horseback riding, rollerblading, and wheel chairs.

- Conservation of open space, water resources, wildlife habitat, scenery, and conservation of cultural resources including interpretation of culturally and historically significant sites.

- Other compatible uses, such as utility rights-of-way, flood control, and storm water management facilities.

The Map - *Light Green*

Recommended Conservation Corridors currently in private ownership are mapped in light green. Public land ownership is mapped in light blue. Although development is encouraged, the scale of the map precludes detailed mapping of potential neighborhood corridors. These should be encouraged and should follow ditches, utility easements and linear parks.

Planning Standards and Guidelines - *Conservation Corridors*

Standards

To facilitate evolution of a network of off-street trails in Conservation Corridors, all bridges, culverts, and street crossing should be constructed to accommodate installation of future, grade separated, crossings by providing appropriate height, width, and sectional area clearances for paths.

Guidelines

Acquire adequate land by fee ownership or easement to allow for construction of future bikepaths meeting federal design standards, particularly horizontal and vertical design standards.

Future bicycle facilities listed in order of construction level include trails, improved soft surface paths, improved paved paths.

Implementation Issues and Action Strategies - *Conservation Corridors*

Issues

Public access to and use rights within designated corridors are limited by ownership, liability, and access issues often precluding immediate bikeway development. Resolution of these issues will require coordination with railroads, irrigation and drainage districts, and private land owners.

Strategies

Initiate legislative changes required to limit landowner liability. Assign the responsibility for resolution of access and liability issues to one or more of the following :

- A designated Bicycle Coordinator
- City/County Attorneys
- Public lands, works, and utilities departments.

Review all proposed utility easement acquisitions for suitability as off-street connectors.

Acquire land or use rights through use contractual agreements, subdivision land dedications or donations, conservation easements, and other similar open space preservation techniques.

Establish an annual allocation within city and county budgets to purchase recreational use rights and critical bicycle routes as opportunities are presented.

Adopt a policy of retaining use rights on roads, utility corridors, and any other public corridors when any are abandoned, sold, or closed.

Management, Land Planning and Maintenance Considerations - *Conservation Corridors*

Management

Conservation Corridor lands, regardless of ownership, should be protected from vandalism and deterioration related to uncontrolled access and incompatible use or development.

Limit vehicular access to public lands to reduce vandalism, particularly under utilized, undeveloped areas most subject to such vandalism. Limited vehicle access and parking should occur along the perimeter, in areas without sensitive ecology easily damaged by such facilities.

Land Planning

Plan and landscape adjacent site development to complement aesthetic quality and access to resources.

Acquire recreational use easements concurrent with drainage and utility easements for regional and neighborhood bike paths.

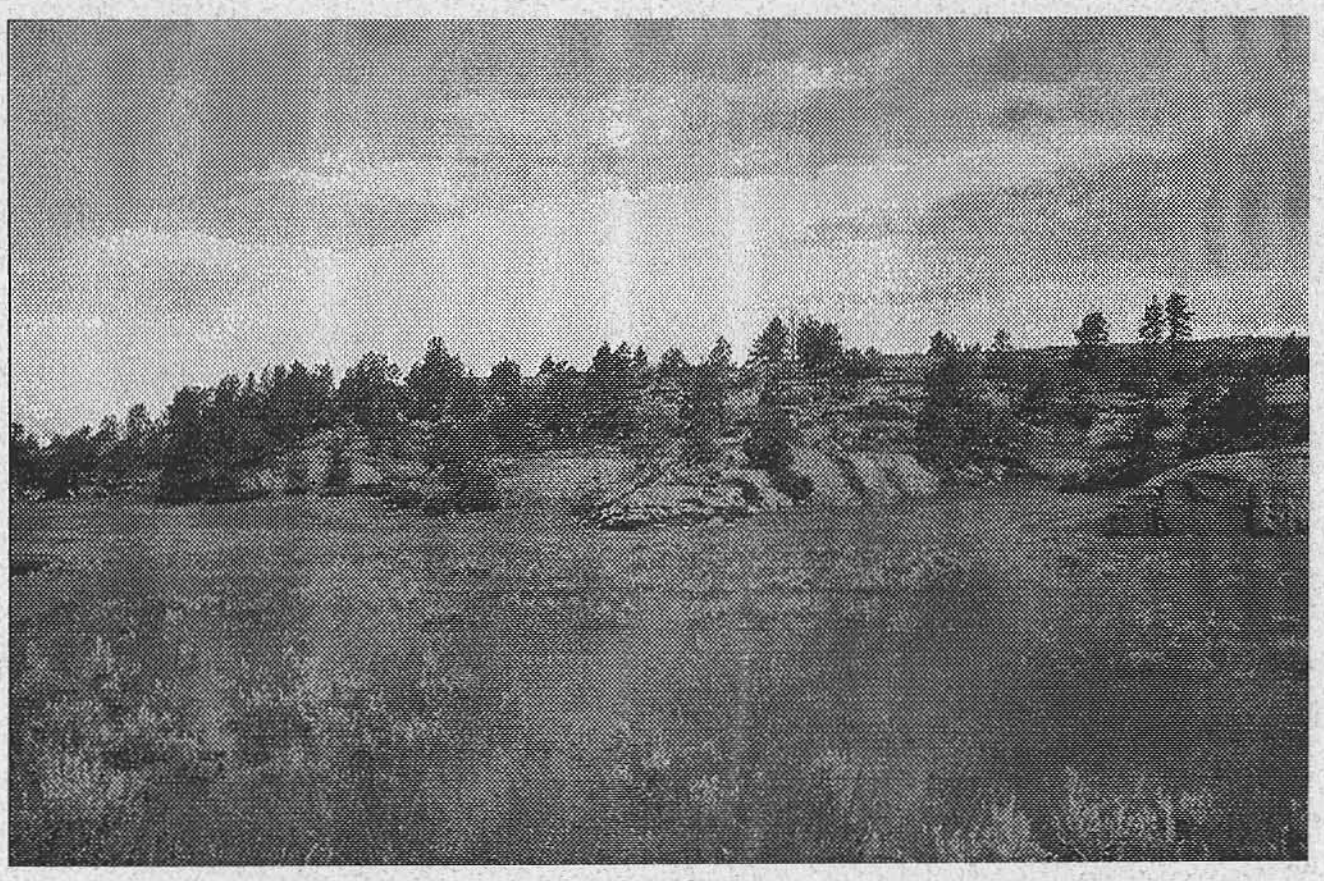
Identify and develop secondary linkages to neighborhoods along streets, ditches, drain-

ages, and utility easements.

Review all utility and road developments and abandoned public projects for relationship to proposed corridors and greenways. Retain or acquire recreational use rights along appropriate utility and road corridors.

Maintenance

Efforts should focus on litter prevention, natural site restoration, erosion control, and trash removal. Vegetation and noxious weed management should be required.



West Alkali Creek

Bike Paths

Bike Paths of regional significance are referred to as TRAC'S to emphasize their potential for multiple uses and benefits including **T**ransportation, **R**ecreation, **A**ccess, and **C**onservation)

Goals - *Bike Paths*

Bicycle Paths and TRAC's will be developed and managed for multiple use and benefit, providing attractive, safe, and relatively direct, off-road transportation access. Located in or adjacent to Conservation Corridors, the proposed routes connect all districts of the area with community resources and activity centers.

Route Characteristics - *Bike Paths*

Bike Paths are improved, continuous, off-road routes developed and managed to complement and connect with on-street District and Neighborhood Connectors, Scenic Routes, and Trails.

Ultimately, paths will connect all districts off-road, with minimal or no crossing of vehicular traffic. Ideally all paths will be continuously off-road and significant in length. Initially, discontinuity may occur, requiring bicyclists to follow existing vehicular roads, alleys, or service roads with low traffic volumes.

These routes are the principal off-road system, often occurring in greenways and providing multiple benefits.

Potential Bike Paths along the Yellowstone River Corridor, rims, Alkali Creek, Blue Creek, rail tracks, the Heights abandoned rail corridor, Shiloh Drain, and proposed West End Drainage System are mapped and are described in detail in Section III of this document.

Users will include cyclists of all ages and abilities who prefer not to interact with vehicle

traffic. A cyclist's selection of these routes may be influenced by recreation opportunities, character, efficiency, or environmental quality Users will include commuters as well as recreational riders. Other users may include runners, in-line skaters, disabled, and pedestrians.

The Map - *Green*

Proposed and potential paths are indicted on the BikeNet Off-Street Plan with green lines. Solid lines are routes on public lands. Examples include locations in the abandoned Heights rail corridor, Metra, and public parks along the river.

Paths without current access rights and which the public has expressed interest in developing are indicated with a bold dashed green line. Examples include locations in/on

tributaries of the Yellowstone River (both sides), active railroad corridors, and the BBWA Canal. Detailed planning processes including successful negotiations with land owners will be required to implement these proposed routes. It is important that paths are included in the Plan to insure consideration in urban growth management and planning processes.

A portion of potential neighborhood paths, including minor utility corridors and in parks or school areas, are indicated as part of the Secondary Neighborhood District Connectors on the On-Street Map (purple). Development of a secondary system of neighborhood bike paths connecting to BikeNet TRAC's is encouraged but difficult to plan at this scale.

No developed BikeNet TRAC's exist. Funds have been appropriated, however, for sections of path along the abandoned railroad corridor in the Heights, Metra Park, and short sections of the Yellowstone River.

Standards - *Bike Paths*

Construction design standards should be flexible and respond to location, corridor characteristics, and level and type of use. Bike paths should be safe and attractive and include appropriate revegetation, landscaping, lighting, signage, and amenities. Unless a variance is granted, horizontal and vertical alignments must conform to AASHTO and FHWA design guidelines.

Paved Paths should be provided when high bicycle speed and volume is anticipated, there is an existing or projected year-round transportation need, and winter maintenance is anticipated. Paved paths, a minimum of 8' and a maximum of 14' should be provided in urban, heavily used areas. The paths should be constructed of concrete and designed to withstand the loading of maintenance vehicles. Where pedestrian use is anticipated, provide for

soft surface (gravel fines), 2' to 3' wide improved shoulders, for walkways.

Unpaved Paths are appropriate when a paved path would cause unacceptable environmental impacts, the above criteria for paving a path are not met, and a trail is still needed. When equestrian use is anticipated, an unpaved path is also appropriate.

Separate Paved Paths and Unpaved Trails should be provided when user conflict is anticipated because of high traffic volumes or the criteria for paving a trail is met but equestrian use anticipated.

Typical sections, construction details, and cost estimates are included in the Project Note Book for improved soft surface and paved paths. Wider, hard-surfaced, sections are

recommended in urban, heavily used, sections of the path. Gravel surfacing may be used initially because of cost constraints and /or in areas of low volumes.

Guidelines - *Bike Paths*

Design all improvements to fit with pathway surroundings and available maintenance provisions. Minimize visual and environmental impacts, and the potential for vandalism.

Alignment

1. Safe, relatively direct routes connecting community resources should provide exposure to natural features and community amenities.
2. Maintain proper scale and aesthetic relationships between greenways, paths, and their surroundings.
3. Locate and design paths to address privacy and security concerns of both users and adjacent landowners.
4. Align to fit the natural terrain and preserve vegetation.
5. Where high wildlife habitat value is present, trail links mainly designed for high volume traffic should be routed around the area.

Access

Design improvements along rivers and creeks to concentrate access at a few specific points rather than along the entire stream bank, thus dispersing use impacts. Bring the path to the water at natural attraction points such as water sounds areas, important views, geologic interest points, and other significant areas.

Landscaping

Except in urban corridors, the landscape should be natural in character and use native species in naturalized arrangements.

Amenities

Plan for and provide occasional viewing and seating/rest areas/ and drinking fountains along paths. Provide opportunities for passive recreation, nature interpretation, and community improvement projects.

Trailheads

Expenditures for trailhead improvements should be limited. Public-private partnering needs to be explored, the sharing of bikeway/ pathway facilities with parks, institutions, schools, and commercial properties. Potential sites include post offices, schools and the Chamber of Commerce (on weekends), parks, Metra Park, Zoo Montana, the Mullowney Lane motels area, shopping centers, and commercial development near the interstate interchanges. Agreements and schedules would need to be negotiated with property managers. Advantages include the willingness of the commercial facililty to promote and distribute pathways information.

Structures

Develop design guidelines and standards for a cohesive family of pathway/bikeways structures. Architectural design guidelines should address bridges, signage, fencing

complementary to the natural landscape and the regional image and character.

Implementation Issues and Action Strategies - *Bike Paths*

Issues

A majority of these trails will be on public land or easements, requiring the paths be developed and administered cooperatively by city and county departments. Interdepartment cooperation will also be required between agencies such as City Public Works, Utilities, and Parks, and County Road and Surveying. Predictable funding will be required to take advantage of opportunities as they arise.

Implementation Strategies

Initially implementation should focus on funded projects including Metra, Heights Rail, and YRPA. For the duration of the CTEP, maximum additional funding should be applied for. Projects should be constructed as demonstration projects. With public support, consideration should be given to a special assessment for construction, administration, and maintenance of additional off-road facilities. If an additional assessment is sought, adequate time to promote and inform the public must be provided.

Use park land acquisition and construction funds to acquire additional land or easements. Limit early expenditures on trail head facilities. Identify opportunities to share parking and restroom facilities.

Establish construction and maintenance standards and requirements for paths developed as part of subdivision or other development projects. Work with developers and development ordinances to provide incentives for land owners/developers to construct and maintain paths and/or grant easements.

Establish a policy and mechanism to compensate landowners for recreational use easements.

Children Can Leard to Ride Bikes In A Traffic Free Environment

Management, Planning and Maintenance Considerations - *Bike Paths*

Management

The issues associated with implementing this bikeways/pathways system are most similar to traditional vehicular transportation projects. Implementation will involve multiple land owners

and require long term corridor planning, land or easement acquisition, engineering, and--potentially--creation of maintenance and improvement assessment districts. The Bicycle Coordinator should be located in the Planning or City Public Works Department with support pledged by related departments, because one agency

All Ages Can EnjoyThe Benefits Of Bike Paths

needs to assume responsibility for overseeing, planning, design and construction of off-road facilities. Benefits will include efficiencies of scale realized in both construction and maintenance of projects.

Planning

To facilitate the evolution of a system of off-street paths,

- Plan and construct bridges, underpasses, and street crossing to accommodate installation of future, grade separated, crossings by providing oversized culverts and clearances.
- Plan and landscape adjacent site development to complement existing aesthetic qualities and provide access to adjacent community resources.
- Limit vehicular access to reduce vandalism.
- Plan infrastructure projects to complement implementation of BikeNet.
- Identify and develop linkages to neighborhoods along streets, ditches, drains, and utility easements.
- Review all utility and road development reconstruction, maintenance, or abandonment projects for relationship to this Plan. Retain or acquire recreational use rights and construct bicycle improvements in conjunction with public infrastructure projects.

Maintenance

Maintenance responsibilities should be addressed during the planning phase of specific improvement projects. At present the City parks department is best equipped to handle the maintenance of Regional TRAC's. An area wide maintenance assessment for pathways/ bikeways should be considered, with the use of one or more greenway assessment districts as an alternative.

Bike Trails

Goal - *Bike Trails*

Develop narrow trails for mountain bikes and other complementary uses in corridors of natural and scenic value such as the Rims and the Yellowstone River Corridor and its tributaries. Existing, minimally improved trails created by the users, will be retained and expanded providing more opportunities for mountain biking and hiking.

Characteristics - *Bike Trails*

Looped trails provide opportunities for hiking, mountain biking, and horse riding. Multiple use trails have been constructed by YRPA. These and similar trails will accommodate mountain bicycle usage at current levels. Eventually a series of trails may evolve to more completely meet the needs of various users. Bike trails should connect to bike paths rather than parking areas to discourage overuse.

Guidelines - *Bike Trails*

Environmentally sensitive areas require a careful balance between the desire for recreation and the protection of natural resources. Determine the appropriate location and manage to maintain appropriate intensity of use.

Locating vehicular trailheads directly on trails is discouraged. Trails should be accessed from paved paths.

Naturalized landscaping focusing on conservation of native species and habitat restoration and enhancement should be encouraged. Locate trails to minimize disturbance to natural systems.

Implementation Issues and Strategies

Implementation issues associated with trails are similar to those previously discussed in association with Bike Paths. Refer to the *Yellowstone Greenway Master Plan* by Wirth and Associates for a detailed discussion of planning and design standards. Because improvements are relatively simple, trails may be developed and maintained by users.

Management Planning and Maintenance - *Bike Trails*

Management

Limit vehicular access to reduce vandalism and overuse.

All trails should be monitored for overuse and additional trails should be developed to mitigate such overuse. Trails are maintained by YRPA along the river. The city and county park departments are responsible for trails on public lands along the Rims. Management should focus on acquisition of use rights to provide continuous looped trails; preservation and conservation of natural systems, and protection of land forms from deterioration. Including trails in potential, future, greenway maintenance districts is recommended.

Planning

To facilitate evolution of a system of off-street trails:

- Plan bridges, underpasses, and street crossings to accommodate installation of future, grade separated, crossings by providing oversized culverts and clearances.
- Plan and landscape adjacent site development to complement aesthetic quality and provide access to area resources.
- Limit vehicular access to reduce vandalism.
- Plan infrastructure projects to complement implementation.

Maintenance

Efforts should focus on reclamation, revegetation, litter collection, restoration, erosion control, and trash removal.

Scenic Routes

Goal

Identify Scenic On- and Off-Street Routes and document their scenic and recreational touring values to encourage preservation of unique qualities as road improvement projects are undertaken.

Characteristics - *Scenic Routes*

Scenic routes selected by advanced bicyclists for touring and recreational bicyclists for scenic qualities. Routes occur on- and off-road. Most on-road routes occur in rural or developing areas and may be paved or unpaved. Several of the routes are state highways with high speed limits. Riders select times to ride when volumes are lowest.

As areas urbanize, many of these routes are planned to be improved as vehicle traffic arterials or collectors.

The Map - *Bike Symbol*

Scenic Routes are designated on the map with symbols. Routes include improved and unimproved roads and paths.Often bicyclists share roadway with vehicles.

Standards - *Scenic Routes*

All road improvement projects must address bicyclists' needs with the objective of preserving environmental and scenic values. Conserve natural attractiveness of routes, and accommodate shared use by vehicles and bicycles.

Guidelines - *Scenic Routes*

Provide continuous looped routes through diverse scenic areas. Identify restrooms and commercial facilities along these routes to promote long distance bicycle rides.

Implementation Strategies and Issues - *Scenic Routes*

Issues

Negotiations with private land owners will be required to bridge a few gaps in existing public land ownership in these areas.

Strategies

Work toward developing long, continuous, or looped trails. Potential for such off-road routes are those south of the Yellowstone River and north of Highway 3. Agreements with public land manager's should be worked out to facilitate preservation and designation of scenic routes through existing public land holdings.

Management

Identify Scenic Routes to insure bicycle considerations during road construction or upgrades. Management considerations may include construction narrower than standard pavement width or excluding parking to preserve the character.

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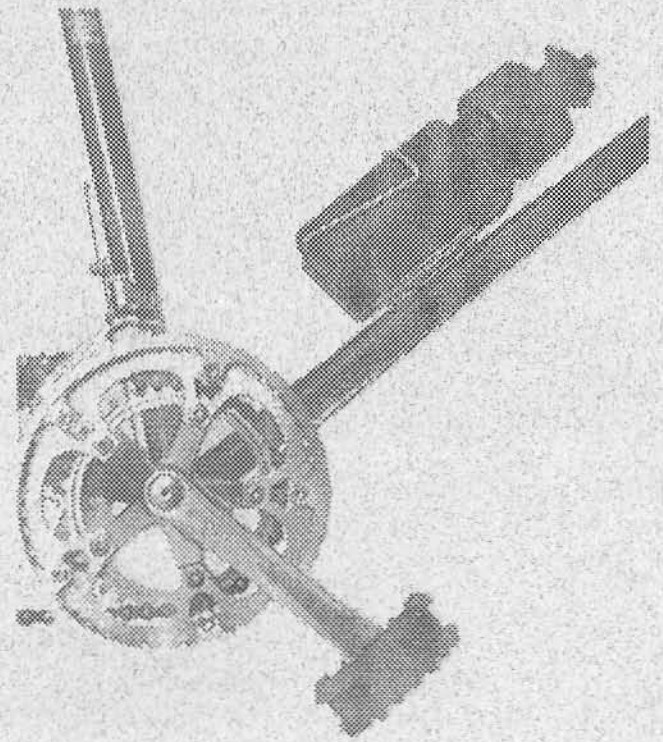
V. PRIORITY PROJECTS AND FUNDING SOURCES



Priorities

Developing a system of bicycle routes for the Billings area is the community's highest bikeways priority. The following projects were identified during the public planning meeting sessions as the most important improvements to such a system. They are listed in relative order of priority.

1. Heights Downtown Connection

Projects proposed to improve the bikeway/path connection from the Heights to Downtown include connecting the proposed Kiwanis and Metra Paths via public land overlooking the Yellowstone River--including Two Moon Park. This project may also eventually include an underpass under Main Street at Alkali Creek, and a connection to Downtown through Metra, under the East Bridge, and along the active rail corridor. 1995 CTEP Funds have been awarded to implement this project.

Estimated cost: $600,000. Partial funding for the Metra and a portion of the path has been approved to include $240,000 in CTEP, DNRC, and Metra Park funds.

2. 6th Avenue Underpass

Improvements proposed include construction of short section of off-road path connecting Eight and Sixth Streets along the rail. The path links to the South Side via Calhoun or to Downtown within the 6th Avenue alignment. The proposed route also connects to the proposed rail TRAC along Montana Avenue.

Estimated cost: $400,000.

3. YRPA Yellowstone River Greenway

Continue trails and paths along the Yellowstone River Greenway. For a detailed description of Improvements refer to *The Yellowstone River Master Plan* by Wirth & Associates, 1994

Estimated cost: $22,000 per mile. CTEP funds in the amount of $95,300 have been allocated to construct a future section of path in 1995.

4. Heights Kiwanis Abandoned Rail Bike Path

A paved path will be constructed within the abandoned rail corridor from Mary Street to Two Moon Park. The path may eventually connect to Lake Elmo State Park along Pemberton and Mary Streets.

Estimated cost: $188,333. Scheduled for 1995 construction. CTEP and FWP funds allocated for this Kiwanis-sponsored project which was funded in 1994.

5. Rimrock Path

Improve existing Black Otter Trail for bicycle use and restrict vehicle access to east end of Swords Park. The project may include construction of drainage, parking, and landscape improvements. Eventually the path may continue west to Sky Ranch Subdivision development west of the Airport on Highway 3. Eventually the path could cross Highways 3, continue north adjacent to the west edge of Airport property and connect to Alkali Creek.

Estimated cost: $270,000.

6. North 27th Street Bicycle and Pedestrian Improvements

An on-street, uphill climbing lane for bicycles and a pedestrian trail following independent alignment south and west of 27th Street is proposed. Intersection Improvements at Airport Road, State Highway 3, and North 27th Street are also needed.

Estimated cost: $85,000.

7. Zimmerman Trail

Provide road widening and drainage improvements to construct uphill climbing lane on Zimmerman Trail. This will require some additional surfacing, relocation of guardrail, and drainage improvements on inside curves.

Estimated cost: $120,000 (plus road improvements).

8. Division Street Crossing

Bicycle Improvements including a westbound contraflow bicycle lane along north side of Clark Avenue would allow bicyclists to Cross Division heading west for easier access to and from Downtown.

Estimated cost: $12,000.

9. On Street System Improvements

Designated system of District Connector On-Street routes connecting all districts on a 1:1.5-mile grid. Signage and striping improvements will be constructed within existing pavement widths. The proposed system is shown in red on the off-road map.

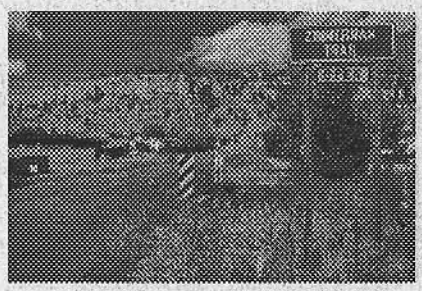
Estimated cost: $ 335,000.

A Safe Connection From The Heights To Downtown Is The Highest Priority

A Bike Path Will Connect To Wendall's Bridge And The Proposed Yellowstone River Greenway

Improvements Are Needed At Division Street To Enhance Connections To Downtown

Lewis Avenue Is A Proposed Primary District Connector



Adding An Uphill Climbing Lane To Zimmerman Trail Will Improve Safety

27th Street Connection To Downtown Will Be Improved By Adding An Uphill Climbing Lane And An Off Street Sidewalk

FUNDING SOURCES

Potential funding sources for bicycle facilities have been identified and are listed below. For a more detailed discussion refer to the BikeNet project notebook.

STATE AND FEDERAL FUNDING

The Intermodal Surface Transportation Efficiency Act of 1991
Surface Transportation Program (STP), Section 1007
Congestion Mitigation & Air Quality(CMAQ)
Section 402 Funding, Federal Transit Funding, Title III, Section 25 of ISTEA
National Recreation Trails Fund Act (The Symms Act)
National Highway System (NHS) Funds, Section 1006, Federal Lands Highway Funds
Watchable Wildlife Program
Community Development Block Grants, Entitlement Program, Small Cities Program
Sponsoring Agencies
State General Funds; State of Montana, Governor's Office
Federal Land and Water Conservation Funds (administered Montana FW&P)
Montana Community Transportation Enhancement Program (CTEP)
Transportation Funds Administered by MDT
DNRC Conservation Grant Program

LOCAL FUNDING

Reallocation of Existing Resources

Local government general funds and parks, public works, engineering, public utilities, and community development funds
Land Acquisition through subdivision development land dedications
Recreational use easements

Special Assessments and Taxes

Special improvement districts, bond issues, and optional sales tax
Developer land dedications
Adverse impact mitigation improvements
Impact fees

Motor vehicle taxes, user or licensing fees

Park dedication requirements--cash in lieu of land provisions

Private Sources

Donations of cash

Fund raising rides and similar events

Rails to Trails Conservancy and other conservation groups

Corporate sponsors

Bank trusts established for bicycle interests

Foundations (local, state, and national)

Volunteer and service organizations

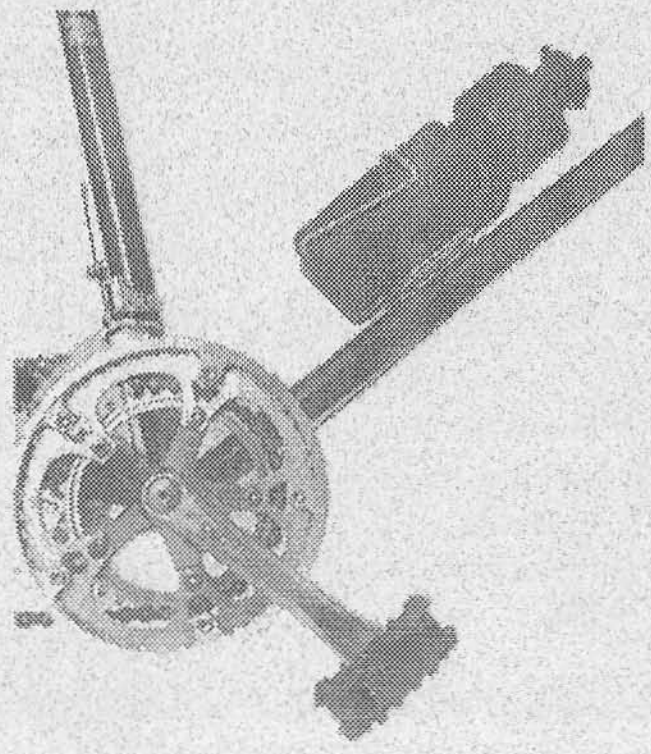
League of American Wheelman

Cost sharing with government

Medical and educational facilities

Land acquisition through donations, conservation easements, and shared use agreements

VI. ENGINEERING DESIGN STANDARDS



An objective of the Bike Net Study was to make recommendations on sound planning guidelines and safe and efficient design standards for bicycle facility development. Specific recommendations on modifications to street design sections and guidelines and standards for developing on and off-street bicycle facilities are included in the previous Section IV Classifications. This section, Design Standards summarizes recommended and future design standards to be adopted and implemented throughout the County now and in the future.

National Standards

AASHTO and FHWA have documented recommended standards and roadway design treatments to accommodate bicycles on a variety of facilities. Alternative facilities include Off- Street Bike Paths and On- Street Bike Lanes, Wide Curb Wide Outside Lanes, Shared Lanes and Shoulders (See Appendix for Definitions). These standards are documented in the following Publications:

Selecting Roadway Design Treatments to Accommodate Bicycles, FHWA Publication No. FHWA-RD-92-073., January 1994

Guide for the Development of Bicycle Facilities, AASHTO Task Force on Geometric Design, August 1991

Tables are included in both documents (and reproduced in this section) for selecting appropriate widths and types of facilities. Factors contributing to the selection of the appropriate treatment include the design cyclist, type of roadway (urban versus rural road section) and traffic operation factors including vehicle speed, traffic volumes, site distance, traffic mix, sight distance, parking, and number of intersections and entrances.

Current State and Local Standards

The State of Montana, Yellowstone County and the City of Billings do not have documented standards for bicycle facilities. Since 1981 most states and localities have relied on *the AASHTO Guide for Development of Bicycle Facilities* as the legally defensible and primary source of planning guidelines and design standards. This publication was revised and updated in 1991 recognizing "the emphasis of bicycle facility programs, and the planning guidelines and design standards which made them are changing". In the past safety issues have been prominent. The updated edition acknowledges " changes in guidelines and standards recognize safety must continue to be emphasized, but access issues must also move into the forefront."

To assist States and localities in obtaining current, state of the art information on bicycle and facility design, a Case Study was commissioned by FHWA as part of the *National Bicycling and Walking Study.* The 1991 document *Case Study No. 24 - Current Planning and Design Standards Being Used By State and Local Agencies for Bicycle and Pedestrian Facilities* presents a compilation of the best

practices in use across the country. The case study report contains model recommendations for planning and design standards.

The study also includes a list of plans and programs exemplifying the best practices and most effective presentations of planning guidelines and design standards found in the United States. These plans are viewed as models for States and localities in the development of state of the art design manuals.

At the top of the list is the *State of Colorado Bikeways Standards and Design Guidelines.* The FHWA publication credits Colorado with " Best new compilation of material from existing plans and guidelines." The Colorado document addresses on and off street facilities and factors in regional considerations into development Standards and Guidelines. Of particularly relevance to Billings is the "Canyon Standards" section. Recommendations in this section are applicable to Zimmerman Trail and the North 27th Street connection to Highway 3.

To avoid excessive duplication of effort, the Colorado document is included in the BikeNet Plan as the recommendation of Standards and Guidelines to be adopted and implemented long term by the City of Billings and Yellowstone County. The following paragraphs discuss recommendations of local adaptations to these standards to allow for immediate improvements to the Bicycle Transportation System in Billings and Yellowstone County.

Local Issues

The lack of any off road bicycle paths and the perception that there are few good roads for safe and comfortable bicycling in Billings and Yellowstone County is an impediment to bicycling. The lack of safe bicycling routes was cited as major concern of participants in both technical and public workshops.

By undertaking the BikeNet Planning process, Billings and Yellowstone County have demonstrated a sincere interest in encouraging and accommodating bicyclists. Administrators have expressed some concern about expenditure of scarce funds on bicycle improvements because current use is low and the pilot project initiated several years ago was not well utilized. Local administrators and transportation officials and engineers have requested the recommendations of BikeNet be realistic, practical and in conformance with national standards.

Early in the planning process, the consultants recognized some modifications would need to be made to existing roadways and current standard street sections and the allocation of pavement width. To assist decision makers in evaluating ways to accommodate on street bicycle facilities, the design team developed illustrations of currently existing standards and alternatives for retrofitting and / or revising current standards to accommodate safe, shared use of roads by bicyclists. Alternatives are included in the Project Notebook. Recommendations are included in *Section V- Route Classifications -Table 2:*

City Standards

The alternatives illustrate that on most existing City streets and current street standards for urban roads widths could be revised

or retrofitted to accommodate bicycles by reallocating pavement width. Retrofitting or revision of standards to include bicycle facilities within the current standard width will require one or more of the following:

1. Reducing the number or width of travel lanes
2. Reducing or removing parking on one or both sides
3. Reducing the width of parking lanes
4. Reducing the current standard width of travel lanes from 12' or 14' to 10' or 11'
5. Reducing the width of, or removing medians and turn lanes

Implementation of these alternatives in some locations is likely to meet with resistance from property owners, the public and local traffic engineers and administrators.

County Standards

Current use of most existing county roads for bicycling requires a shared lane due to limited pavement width and narrow shoulders. National standards recommend a 6' paved shoulder for streets with volumes over 2000 ADT bringing the total street width to 36'. Although ideal, the feasibility of improving standards and increasing pavement width by 12' in the immediate future is not realistic.

Recommendation

The recommendation of this plan is to begin the evolutionary process of making improvements to the bicycle transportation system working toward implementing of a county-wide system of streets and paths conforming to national standards. In the immediate future some facilities will not meet current standards but will improve the safety of Bicycling.

Local Adaptations

After an extensive review of existing conditions, alternative standards, cost effectiveness, and feasibility of implementation, BikeNet planners reached the following conclusions:

1. It is cost prohibitive to provide bicycle facilities meeting recommended national standards on all streets in the planning area in the near future. The process of improving bicycle accommodations should begin immediately with a goal of building a future system conforming to national standards.

2. Immediate efforts within the City should focus on retrofitting existing and standard street pavement widths and standards with wide outside lanes a minimum of 15' in width. Highest priority should be designation, restriping and identifying with pavement markings the priority network of District Connectors. Alternatives for retrofitting and recommendations for modifications to current street standards are described on Table 2 behind foldout maps

3. A more realistic and cost effective modification to current county roads standards will be to provide paved shoulders on priority routes. The county should be encouraged to build minimum lane widths of 11-12' with 3' to 4'

paved shoulders along bicycle routes. This will provide wide outside lanes a minimum of 15' in width, resulting in roads narrower than recommended standards but wider than the current 24' standard. Highest priority should be given to the identified system of bicycle arterial and primary district connectors. These often correspond to scenic touring routes, State Highways and Rural Arterials.

National Precedents

Denver has adopted a standard of 15' Wide Outside Lanes with 11' inside vehicle lanes. Routes are designated using MUTCD approved stencils rather than Bike Lane striping . The standard section consists of two 11' travel lanes and two 15' outside lanes with or without parking. Stencils are placed three or more midblock at least 50 feet back from the intersection

Benefits of this approach include:

- Safer Routes
- Improved bicycle level of service.
- More economical to implement and maintain
- Stencils on wide outside lanes legitimate bicycle usage, alert motorists to their presence and provide discrete on-street space for bicyclists.
- Bicycle lanes can be dangerous for various reasons. If stripes are painted all the way to the intersection, inexperienced cyclists may ride too close to the curb through the intersection , increasing the chance of collision with turning motorists.
- Wide Outside Lanes minimize maintenance needs and reduce hazards associated with maintenance limitations. Bike lanes also tend to accumulate sand and gravel because the sweeping action of cars blows debris to the sides of the road.
- Excessively wide roads are discouraged as wider roads can encourage greater automobile traffic speeds, creating conditions that are potentially more dangerous to bicyclists. Use of wide outside lanes will allow Billings to retain wider lane standards without excessively increasing pavement widths.

Standards adopted by communities in Colorado, Oregon and Washington for retrofitting existing streets often reduce vehicle travel lane widths to 10' and parking lanes to as narrow as 7.5'.

Other Considerations:

FHWA Publication No. FHWA-RD-92-073, January 1994 state:"Where a facility is intended to be designated as a "bicycle facility" it is essential the design conform to the State Standards or AASHTO guidelines." Designation of facilities is preferred by basic and younger cyclists. When the available width is less than recommended standards it should not be designated as a facility. In order for Billings/ Yellowstone County to implement a bicycle plan, modification to existing State Standards will be required.

Wide Curb and Shared Lanes on roads with high traffic volumes are not appropriate solutions for Type B&C Cyclists. Accommodating Type B&C Cyclists is most important to increas-

ing bicycle usage. On Urban Arterial routes designated as District Connectors, lanes may be more appropriate.

Attached Standards

The following section is an except from the state of Colorado Design Guidelines. Recommendations on lane and width standards are greater and are included as recommended standards for the future Billings system. Other included CDOT standards pertaining to geometry and bikeway design standards are immediately applicable.

Off Street Routes

National "standards" for multiuse trails do not exist. Three publications FHWA acknowledges as doing an "excellent job of addressing the issue of multi use and providing applicable guidelines" include:

1. *Guidelines for Creating Greenways* co authored by Flink and Searns and published by Island Press

This document looks at greenways comprehensively including route selection corridor widths and multipurpose trails. Six types of treads for multi-use trails accommodating different types of users are described with standards.

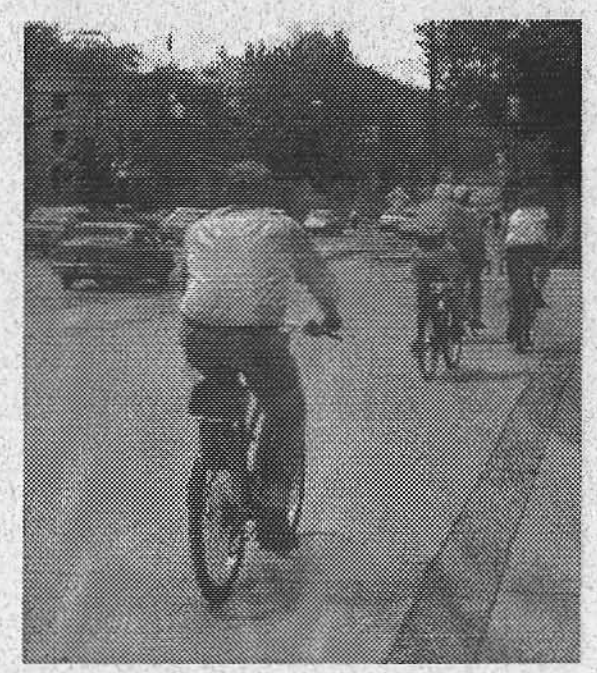
2. *Pennsylvania's Non Motorized Trails / An Introduction to Planning and Development*

This document contains an excellent discussion on surfacing types stating: there is no one best material for all trails. Items such as user density, location, terrain, soils, budget and use by other vehicles all have an effect on surface materials choice".

3. *The Rails to Trails Conservancy Design and Management Manual for Multi-Use Trails.*

This publication recommends trail widths, vertical and horizontal clearances.

Typical sections are included for consideration when bikeways are developed as a component of a Multi-Use Trail. Proposed TRAC's described in Section 3- The Plan are examples of potential multi-use corridors.



State of Colorado Bikeway Standards And Design Guidelines

17.0 BIKEWAYS

17.1 Introduction

This chapter is meant to provide the design and engineering information necessary to construct efficient, cost-effective and low-liability on-street and off-street bikeway facilities. Below are a few points of clarification regarding bikeway design in Colorado and of this chapter and its use.

* These guides take into consideration that the bicycle is a vehicle according to Colorado State Law, and that cyclists are entitled to share the roadway with other vehicles except where expressly prohibited. Improvements for motor vehicles should avoid adversely impacting bicycling, and bicycles should be accommodated wherever cycling is permitted.

* The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) federally mandated the development of State and Municipal Planning Organization (MPO) bicycle master plans. The Colorado Bicycle Master Plan is developed through the CDOT Bicycle Program by integrating Regional Transportation Plans into a statewide bicycle transportation network. All relevant projects should be coordinated with the Bicycle Program Manager and the Colorado Bicycle Master Plan.

* The information in this guide was developed using the 1991 AASHTO Guide for the Development of Bicycle Facilities and bicycle design guides from other states and municipalities. All design guidelines meet or exceed federal guidelines. Use of these design guides by other Colorado agencies and municipalities is encouraged, but not mandatory, unless funds awarded through the State are used on local projects.

* The guidelines in this chapter accommodate the operating characteristics of basic bicycles for both roadway improvements and separate paths. Design modifications (e.g., widths, curve radii, superelevations, etc.) may be necessary to accommodate bicycle trailers or tandems, particularly in high volume urban and bicycle tourism areas.

* Developing bikeways from the perspective of the bicyclist, with motorist interaction in mind, is highly encouraged as it leads to more successful bikeway projects. Bicycle Facility Design Training Classes are available to all CDOT employees and others. Contact the Bicycle Program Manager- 303-757-9982, for classes and other bicycle-related information.

* Deviations from mandatory standards shall be considered on a case-by-case basis, and the rationale clearly documented by the implementing agency. It is not the intent that deviations be used for the purpose of permitting wholesale exemptions for substandard facilities.

17.2 Definitions

Adult Bicyclist- Any person 13 years of age or older.

Bicycle- Every vehicle propelled solely by human power applied to pedals upon which any person may ride having two tandem wheels or two parallel wheels and one forward wheel, all of which are more than fourteen inches in diameter.

Bicycle Transportation- For the purposes of this guide, is defined as getting from Point A to Point B, regardless of the trip purpose (commuting to work, travel for exercise, pleasure or errands) or distance. A bicycle transportation trip can be thought of as any trip which would replace a motor vehicle trip.

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.

Bike Path- A bikeway physically separated from motorized vehicular traffic by an open space or barrier, either within the highway right of way or within an independent right of way.

Bike Route- A roadway distinguished by signage only, which provides continuity to other bicycle facilities, or is designated as a preferred route through high demand corridors.

Bikeway- Any road, path, or way which in some manner is specifically designated as being open to bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.

Multi-use- Usually refers to paved pathways, indicating facilities shared by bicycles, pedestrians, roller-bladers, joggers, and other non-motorized forms of transportation, usually excluding horses. Multi-use facilities are usually restricted to off-street paths.

Roadway- That portion of a highway improved, designed or ordinarily used for vehicle travel, exclusive of the sidewalk, berm, or shoulder even though such sidewalk, berm or shoulder is used by persons riding bicycles or other human powered vehicles and exclusive of that portion of a highway designated for exclusive use as a bicycle path or reserved for the exclusive use of bicycles, human powered vehicles, or pedestrians.

Shoulder- That portion of roadway *exclusive* of the travel lane designated and ordinarily used for vehicle travel. It is that portion of the roadway to the outside of the white line. Colorado Bicycle Law 42-4-106.5-(5) states :*"...where a paved shoulder suitable for bicycle riding is present, persons operating bicycles shall ride on the paved shoulders."* A paved shoulder is a de facto bikeway when present, but is different from a bikelane in that it is not signed nor meant exclusively for the use of bicycles.

Shared Roadway- Any roadway upon which a bicycle lane is not designated and which may be legally used by bicycles regardless of whether such facility is specifically designated as a bikeway.

Sidewalk- The portion of a highway designed for preferential or exclusive use by pedestrians.

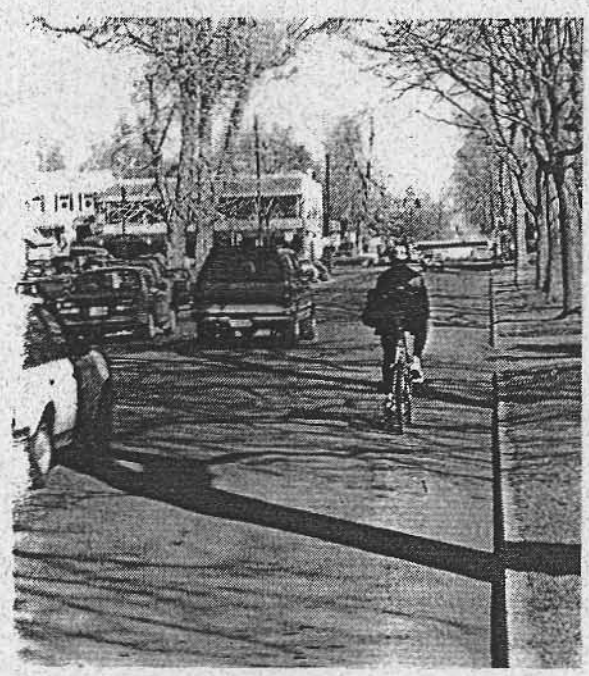
Youthful Bicyclist- Any person under 13 years of age.

Wide Curb-Lane- A curb-lane which is of such width that bicycle and motorized traffic can be accommodated in the same lane. This lane shall always be the through lane closest to the curb, or shoulder edge of the road when a curb is not provided.

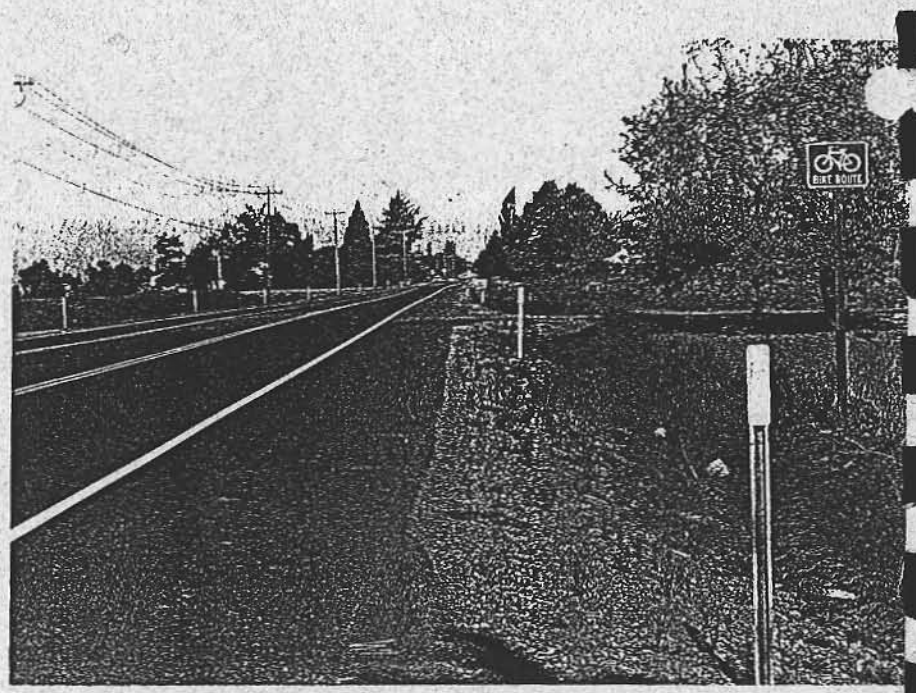
The terms "bikeway," "bike path," "bike route," and "bike lane" are often used interchangeably, which can be confusing. Using the proper term when discussing facility types avoids confusion. The pictures below are included for clarification.

Bike Lane

Bike Path



Wide Curb-Lane



Shoulder

These are all "Bikeways."

Figure 17-1

17.3 Bikeway Functions

The function of a bikeway is to provide safe and efficient transportation for cyclists without impairing the movement of other modes of travel. A bikeway can be either an on-street or an off-street facility depending on a number of factors, including the skill level of the cyclist, the trip purpose, destination, and the physical environment.

Well-conceived bikeways can have a positive effect on both bicyclist and motorist behavior. Poorly conceived bikeways can be counterproductive to education and enforcement programs, as well as being a hazard and a liability. Appropriately designed shared roadway facilities positively affect the level of service for motor vehicles, are usually less expensive than off-street facilities, and are often easier to maintain. Well-designed off-street paths can provide shortcuts, non-stop connections, and a more pleasant cycling environment for the users. No facility at all is better than a facility which creates conflicts, encourages unsafe riding habits or promotes violations of the law.

In order to develop a bikeways system which will benefit cyclists, and which cyclists will safely and willingly use, it is important to understand their transportation needs and issues. Sections 17.3.1 through 17.3.5 summarize bicyclists as a modal user.

17.3.1 Bicycle User Groups

There are two basic types of bicycle facility users. The degree upon which they fit into one of these groups varies:

"Group A"- Skilled Cyclists

Skilled cyclists are experienced riders who usually prefer traveling on the roads which, for them are often safer and more efficient than off-street paths. These cyclists are interested in using off-street paths if they are separated from slower, less predictable pedestrian traffic, are designed for higher speeds, and offer a more efficient and more pleasant environment than the closest alternative roadway.

"Group B"- Less Skilled, Youthful, or Family Cyclists

These cyclists are uncomfortable in traffic. They can be cycling either for recreation or transportation, may be traveling at slower speeds and for shorter distances, and seek out paths that are easy to moderate in difficulty. They may require frequent rest stops.

Most parents discourage younger, less experienced cyclists from cycling on roads, especially busy roads that are not appropriately designed to accommodate cyclists. When properly designed, bike paths can provide more appropriate cycling for this group. Paths that are designed to by-pass highways and busy streets, as well as provide direct connections between parks, open space, schools, recreation centers, shopping malls and other youth-oriented destinations are especially useful.

Family cyclists are those who bicycle as a family and often have young children in trailers or bike seats, or on small bikes. Residential streets, bike lanes or sidewalks often provide linkages to off-street bike paths. When these linkages are not feasible, these cyclists often drive to trailhead parking to access a path.

Cyclists Law of Perpetual Motion-
"Once in motion, cyclists will do almost anything to avoid losing momentum."

Skill level, need and expected usage should be reflected in the design of the bikeway and its alignment. Section 7.5.1.10, Tables 1-3 identify the appropriate type of facility and proper width.

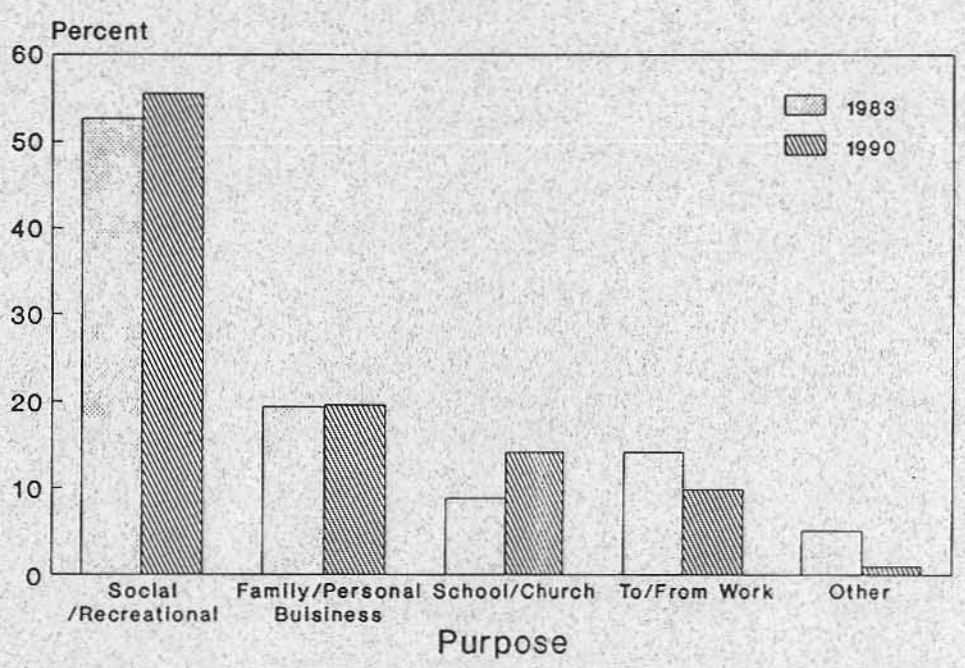
17.3.2 Reasons People Bicycle:

* As a primary mode of transportation;
* Recreation/pleasure;
* Fitness;
* Environmental ethics;
* Utilitarian purposes;
* They find it more convenient than other modes of transportation; or,
* Any combination of the above.

17.3.3 Cyclist Destinations

In addition to trips made specifically for fitness purposes, cyclists will travel to all of the same places that motor vehicle drivers do:

* From town to town or state to state;
* On vacation;
* To work, school, shopping or other errands;
* To intermodal linkages such as bus and train stations;
* To a friend's house, parks, and recreation areas; or,
* Nowhere in particular, as a pleasure trip.



***National percent distribution of bicycle trips by purpose and year**, from "Injuries to Bicyclists: A National Perspective," John Hopkins University Injury Prevention Center, 1993.*

Figure 17-2

17.3.4 Safety Concerns- Real vs. Perceived

There is often a difference between actual safety and what is perceived to be safe. Cyclists, motorists, and transportation engineers sometimes perceive an action or a facility to be safe when, in fact, it may be more dangerous, or vice versa. The following chart illustrates this:

Perception	Reality
It is safer to bicycle facing traffic.	Bicycling against traffic is one of the leading causes of bicycle fatalities, especially among children.
Interstates are one of the most dangerous places to bicycle.	Nationally, interstate bicycle crashes are low compared to other roadway types.
Cycling on the roadway and mixing with motor vehicle traffic is dangerous. Bike paths are much safer.	75% of all bicycle crashes do not involve motor vehicles. More crashes happen on paths than on-street, often involving at-grade crossings such as driveways & intersections, or other path users. Cyclists are safest when they act in traffic according to operational protocols assigned motor vehicles, or when cycling on uninterrupted, grade- and mode-separated paths.

17.3.5 Motor Vehicle/Bicycle Crash Summary

The types of motor vehicle/bicycle crashes involving adult bicyclists are different from those involving youthful bicyclists. Crashes can be reduced if potential hazards are anticipated and effectively mitigated by appropriate design, with the major user type in mind. Approximately 75% of bicycle crashes do not involve motor vehicles, but are a result of excessive speed, poor surface conditions (including gravel, ice and snow), mechanical failures, loss of control, or a collision with a pedestrian or other object.

The most common types of bicycle/motor vehicle crashes are listed below. The motorist is most often at fault in adult crashes and the cyclist is most often at fault in children's bicycle crashes.

Children	Adults
#1 Cyclist rides on wrong side of road against oncoming traffic.	#1 Motorist turns left into oncoming bicyclist heading straight.
#2 Cyclist turns or swerves left without looking, hit from the rear by passing vehicle.	#2 Motorist turns right into bicyclist heading straight in the same direction.
#3 Cyclist rides out from residential driveway or off sidewalk or curb into traffic.	#3 Motorist drives out from driveway or through stop sign.

Experience has shown the compatibility of motor vehicles and bicycles on the roadway. Shared roadway facilities (paved shoulders, wide curb lanes, bicycle lanes, and bicycle routes) in many cases afford greater safety for the bicyclist than on some separated facilities such as sidewalks or bike paths parallel to roadways. Poor visibility, conflicts with motor vehicles at intersections and driveways, lack of space for bicycle maneuvering, and general awareness and behavior patterns of both the cyclist and the motorist are reasons why parallel off-street facilities can be more of a liability than an asset.

17.4 Facility Type and Selection

17.4.1 General Guides

17.4.1.1 On-street vs. Off-street

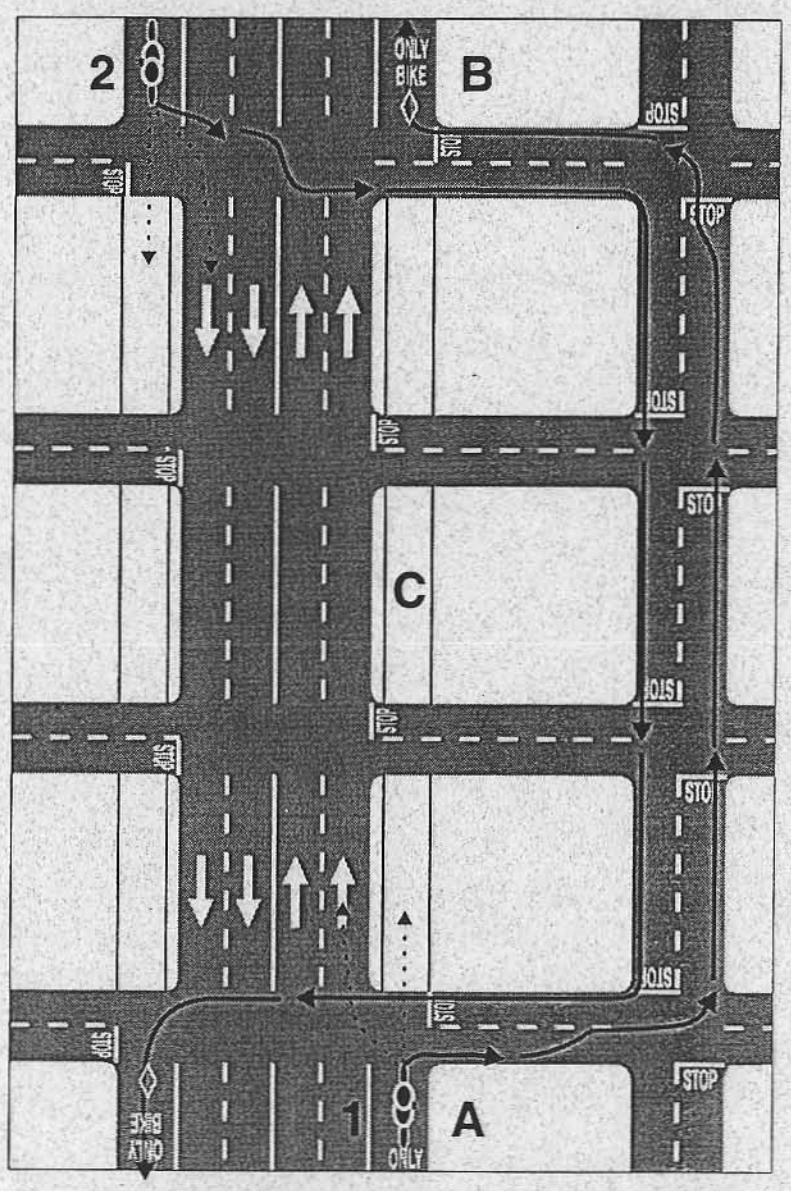
The decision whether to build an off-street or on-street bikeway should be decided on a case- by-case basis. Generally, on-street facilities should be considered first because they are usually less expensive to build and maintain and are also an improvement for other modes of transportation. An off-street path may be a better choice if it would provide better connections, be more scenic, and be a more efficient transportation route than an on-street facility without posing a hazard at intersections. The presence of heavy truck or bus traffic, the need to accommodate a cycling environment for the bicycle tourism industry and/or youthful bicyclists, may also lead to a decision to provide an off-street path. Providing both on-street and off-street facilities for both Group A and Group B cyclists, particularly in urban areas, will accommodate the greatest number of cyclists.

17.4.1.2 Continuity

Alternating segments of off-street and on-street facilities along a bikeway corridor is ill- advised, as street crossings by cyclists are often required when the route changes character. If the bike path is only on one side of a road, wrong-way bicycle travel will occur on the street beyond the ends of the bike path because of the inconvenience of having to cross the street to be on the correct side. Where bikeway type changes are unavoidable, the transition from one type to the next should be user-friendly and connect logically. (*See Figure 17-4 .*)

17.4.1.3 Connectivity

Every effort should be made to provide attractive routes that have convenient access points, destinations and linkages. Bicycle access to activity centers, major destinations, and intermodal linkages such as transit or train stations, park-and-rides, or bus stops, should be considered with all highway and other appropriate projects. Adequate planning for these linkages will increase the use of the bicycle facility for utility as well as recreational trips.



WHY CYCLISTS PREFER A THROUGH ROUTE

1. It is the shortest distance from "A" to "B" (The less-travelled street adds a distance of at least **twice** "n" feet, more if it meanders)

2. There may be destination points along the thoroughfare (e.g. at "C"), such as businesses, stores, schools or employment centers.

3. The less-travelled street will often have many stop signs; traffic on the thoroughfare will have the right of way, and signals that favor through traffic over side streets.

4. Potential conflict points are increased with rerouting, **especially for cyclists who are required to cross the thoroughfare twice** (bicyclist #2).

CONSEQUENCES OF NOT PROVIDING BIKEWAY ON THOROUGHFARE

1. Because of the above reasons, many cyclists will choose to stay on the thoroughfare, even with no bike lanes, causing possible safety problems and reduced capacity (Bicyclists riding slowly in a narrow travel lane can cause traffic delays).

2. Circuitous bike route signing that is ignored breeds disrespect for other bicycle signing.

3. Some motorists will not respect bicyclists who are perceived to be "riding where they don't belong".

Hazards of Routing Cyclists Off Throughfares onto Less-traveled streets
Dashed lines show movements which most likely result in bicycle\auto and bicycle\pedestrian conflicts

Figure 17-3

17.4.2 On-street Facilities

On-street bikeway facilities include bike lanes, wide curb lanes, shoulders, and designated bike routes. On-street facilities are generally less expensive than separated paths, and often improve automobile traffic capacity, snow storage, road maintenance operations, and reduce crashes (auto/auto and auto/bicycle) along these corridors. Experienced cyclists who travel long distances prefer interstate and other through highways as they are often the most efficient method of travel.

A highway or other motorized facility where speeds exceed 55 mph (87 km/hr) or where daily volume exceeds 40,000 vehicles and numerous interchanges are present, should not be designated as a bicycle facility. Highways which exceed these speed and volume limits are acceptable if there is a minimum 8 foot shoulder.

Roadways where motor vehicle speeds exceed 35 mph (56 km/hr) or where the traffic volume exceeds 10,000 vehicles per day should not be recommended for use by youthful or inexperienced adult bicyclists. When these limits are exceeded, alternate routes with speeds and volumes below 35 mph and 10,000 vehicles per day should be provided.

17.4.2.1 Bike Lanes

Bike lanes are established along streets in corridors where significant bicycle demand is desired or expected, and where they can serve distinct needs. The purpose should be to improve conditions for cyclists in the corridors and to encourage more cyclists to use those corridors. Bike lanes are desirable when traffic volumes or speeds are such that wide curb-lanes are not practical. Other corridors that may warrant bike lanes include:

- Corridors with heavy bicycle traffic, especially where cyclists must frequently pass each other travelling in the same direction.

- Corridors where frequent nighttime bicycle use is expected.

- Corridors with limited residential or commercial driveways, or roadway intersections.

Because bike lanes provide a channelizing function, they should be considered when it is desirable to delineate the right-of-way assigned to cyclists and motorists and to provide for more predictable movements by each.

Minimum Width for Bikelanes is 5 Feet Excluding Gutter Pan

Figure 17-4

17.4.2.2 Wide Curb-lanes

Wide curb-lane facilities are selected when there is insufficient room for a separate bike lane, when there are frequent intersecting streets and driveways, and/or where there is high turnover on-street parking. Wide curb lanes can accommodate shared bicycle/motor vehicle use without reducing roadway capacity for motor vehicle traffic. They can also minimize both the real and perceived operating conflicts between bicycles and motor vehicles and increase the number of cyclists capable of being accommodated. The added lane width provides more maneuvering room for motorists entering the roadway and better accommodates buses and other wide vehicles. Wide outside lanes require the least amount of additional maintenance of the different facilities, as the sweeping effect of passing motor vehicles and routine highway maintenance is usually enough to keep the lane free of debris.

Wide curb-lanes are appropriate bicycle facilities where traffic speeds and volumes are tolerable for shared roadway facilities .In general, roadways where speeds do not exceed 30 mph and volumes are not higher than 2000 vehicles per day are acceptable for wide curb-lane facilities. As a general guide, wide-curb lanes should typically not be designated as bike routes if they carry truck/bus volumes of more than 5 percent of average daily traffic (ADT). Bike lanes or shoulders may accommodate bicycle traffic on roadways with a truck/bus volume of more than 5 percent. For a complete list of roadway applications refer to Tables 1-3 starting on page 26.

17.4.2.3 Designated Bike Routes

Bike routes are shared facilities which serve either to provide continuity to other bicycle facilities (usually bike lanes), or to designate preferred routes through high-demand corridors. Bike routes are accommodated on existing street and highway systems as they presently exist. As with bike lanes, designation of bike routes should indicate to cyclists that there are particular advantages to using these routes as compared with parallel or adjacent routes. This means that both design and operational actions must be taken to ensure that these routes are suitable as shared routes and will be maintained in a manner consistent with the needs of cyclists. The roadway width, volume, speed, type of traffic, parking conditions, grade, and sight distance should be considered. Improvements to drainage grates, railroad crossings, pavement, and responsiveness of signals to bicycles may be necessary before route designation. Because of their aerodynamic effect, width, and overhanging mirrors, trucks, buses, motor homes and trailers can cause special safety problems for bicyclists. If there is a choice between comparable routes, the route with the lower truck and bus traffic volume is preferable.

17.4.3 Off-Street Facilities

17.4.3.1 Bike Paths

Off-street facilities, better known as bike paths or trails, generally should be used to serve transportation corridors not served by streets and highways, or where rights-of-way exist permitting such facilities to be constructed away from the influence of parallel roads. Bike paths should offer opportunities not provided by the road system. They can either provide a recreational opportunity, or can serve as direct commuter routes if cross traffic by motor vehicles can be minimized and geometric standards can be upheld.

The most common locations for off-street facilities are along rivers, canals, utility rights-of-way, abandoned railroad rights-of-way, within college campuses, or within and between parks and open space. There may also be situations where such facilities can be provided for transportation and recreation as part of the site planning process. Common application is to eliminate impediments to bicycle travel caused by freeways, rail corridors, inadequate rights-of-way width, problem intersections, or because of the existence of natural barriers. Off-street facilities should be designed with a minimum of at-grade street crossings to avoid automobile/bicycle conflicts.

17.4.3.2 Multi-use Paths

Multi-use paths are off-street facilities shared by bicycles, pedestrians, roller-bladers, joggers, and other non-motorized forms of recreation. When properly planned and designed, multi-use paths can also serve as bicycle transportation corridors, especially during times when the multi-use path is not frequented by other path user groups, such as weekday rush hours. Cyclists and pedestrians should have separated facilities whenever possible in high volume urban areas.

Shared use between bicycles and horses creates an unsatisfactory mix. A horse startles easily and may kick out suddenly if it perceives the bicyclist as a danger. A bike path and a bridle path are also incompatible in their surface design requirements. Bicycles function best on hard surfaces; horses function best on soft surfaces. A compromise to accommodate both uses would result in a less than adequate surface for both. Therefore, it is recommended that a separate equestrian trail be provided that is designed and planned to minimize horse/bicycle conflicts.

17.4.3.3 Off-street Paths Adjacent to Roadways

Off-street paths immediately adjacent to streets and highways are not recommended for the following reasons:

1. At intersections, intersecting driveways, and at commercial strip developments, etc., motorists entering or crossing the highway often will not notice cyclists coming from their right, as they are not expecting contra-flow vehicles. Motorists often do not look for cyclists or pedestrians from either direction on what is typically a sidewalk area.

2. When the bike path ends, cyclists riding against traffic will tend to continue to travel on the wrong side of the street. Likewise, cyclists approaching a bike path often travel on the wrong side of the street in getting to the path. These maneuvers are both illegal and dangerous.

3. When constructed in narrow roadway rights-of-way, the paved shoulder is often sacrificed, thereby decreasing safety for motorists and cyclists using the roadway. This also results in gravel, snow from plows and other debris being thrown up onto the path.

4. Many cyclists will use the highway instead of the bike path because they have found the highway to be safer, more convenient or better maintained. Cyclists using the highway are often subjected to harassment by motorists who feel that cyclists should always be on an adjacent path.

5. Cyclists using the bike path generally are required to stop or yield at all cross streets and driveways, often leading to the motor vehicle driver's confusion and the cyclists' frustration. Cyclists using the highway usually have priority over cross traffic, because they have the same right-of-way as motorists.

6. Stopped cross street motor vehicle traffic and vehicles exiting driveways or parked on side streets may block the path crossing.

7. Because of the close proximity of motor vehicle traffic to opposing bicycle traffic, barriers separating the two modes are often necessary due to the possibility of loss of vehicular control. These barriers can be a hazard to both modes, and can complicate path maintenance and drainage, and can cause visibility and other problems.

For the above reasons, bike lanes, wide curb-lanes, or bike routes are generally the best way to accommodate bicycle traffic adjacent to highway corridors.

17.4.3.4 Bike Paths in the Median of Highways

As a general rule, bike paths in the median of highways are not recommended because they usually require movements contrary to normal rules of the road. Problems include:

1. Bicycle right turns from the center of roadways are unnatural for cyclists and confusing to motorists.

2. Proper cyclist movements through intersections (even with signals) are often confusing to motorists as well as cyclists.

3. Left-turning motorists must cross one direction of motor vehicle traffic and two directions of bicycle traffic, increasing conflicts.

4. Where intersections are widely spaced, cyclists often enter or exit bike paths at mid-block locations.

5. Where medians are landscaped, visual relationships between bicyclists and motorists at intersections are impaired.

For the above reasons, bike paths in the median of highways should be considered only if the above problems can be avoided. The extra expense of a median path versus an on-street improvement, such as shoulders, is not justifiable unless safety, access to destinations, and a quality experience can be better provided through this type of facility.

17.4.3.5 Sidewalks as Bikeways

Most sidewalk bike facilities are unsatisfactory for both skilled and less skilled cyclists for a variety of reasons:

- They are primarily or exclusively designed for pedestrians and are not safe for higher-speed use;

- Bicycle/pedestrian conflicts. Pedestrians travel at lower speeds, and are exiting stores, parked cars, etc.;

- Cyclist conflicts with fixed objects such as parking meters, utility poles, sign posts, bus benches, trees, fire hydrants, mail boxes, etc.;

- At intersections, motorists are often not looking for cyclists 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;

- Sidewalks can encourage wrong-way cycling;

- Cyclists develop a false sense of security when bicycling on sidewalks, tending to pay less attention and cycling less defensively;

Constructing very wide sidewalks does not necessarily add to the safety of sidewalk bicycle travel because it can encourage higher-speed bicycle use and increase the potential cycling conflicts with motor vehicles at intersections, as well as with pedestrians and fixed objects.

While sidewalks are generally not acceptable for cycling, in a few limited situations sidewalk improvements can be beneficial. Sidewalk facilities can be used by youthful bicyclists and, under some very special conditions, they may become part of an adult bikeway system.

In residential areas or areas near elementary schools and parks where young, inexperienced children are the primary riders, the addition of curb ramps, the removal of obstacles, etc., can aid in making a sidewalk an appropriate bicycle facility for youths. This type of sidewalk bicycle use is accepted, but it is inappropriate to sign such facilities as bike paths. Such provisions for youthful cyclists should be in addition to, rather than instead of, the provisions for the adult cyclist.

The provision of sidewalks for experienced bicyclists can be considered as an interim measure, or as a last resort because of lack of space or other physical constraints. The only sidewalks which should be evaluated for use by adult cyclists are those on long or narrow existing bridges, or those in rural areas where little, if any, pedestrian traffic on the sidewalks occurs. These facilities should have adequate space for cyclists, be uninterrupted by driveways and intersections for long distances, and have approach ramps at intersections. If approach bikeways are two-way, the sidewalk facility should also be wide enough to accommodate two-way bike traffic.

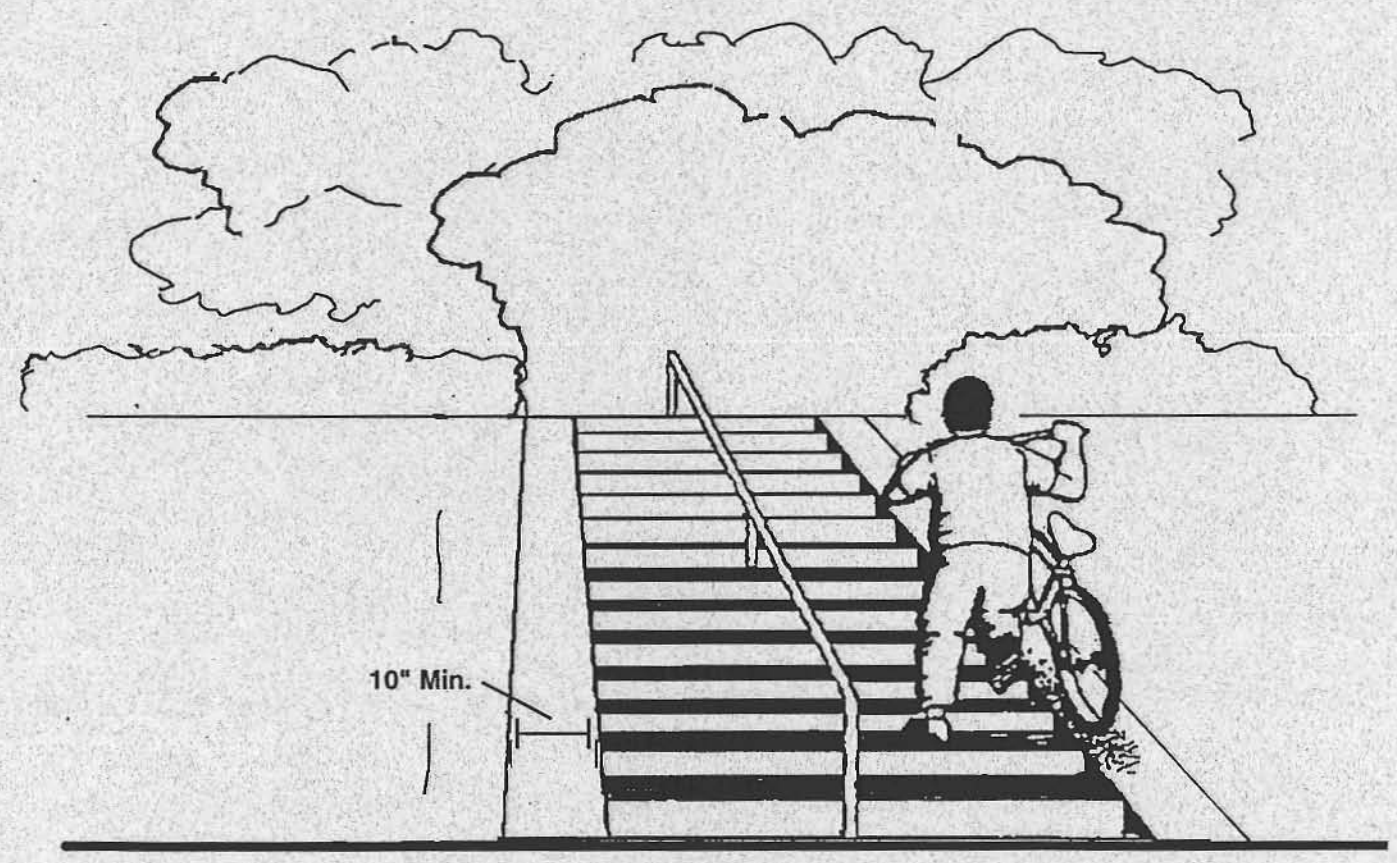
17.4.3.6 Bicycle Parking

Bicycle parking is an important link in a comprehensive bicycle and multimodal system. If parking is not available at destinations and transportation links, the incentive to use bicycles as a means of transportation is seriously undermined. Where adequate parking is not provided, cyclists will lock their bicycles to the nearest available object, whether is it a tree, post, parking meter, or handicap ramp. This is undesirable as it damages trees, produces bicycle clutter, and can be potentially dangerous to pedestrians.

For security, bicycle parking is best located in clear view of a main entry where any tampering would be noticed. Bicycle parking may be short-term or long-term and can consist of bike lockers (high security), bike racks, or a combination of the two. Contact the state Bicycle Program Manager for information regarding bicycle parking.

17.5.2.7 Stairways

Staircases can pose a problem for cyclists if the bicyle has to be carried up or down a staircase. A simple solution is to build ramps on either side of the staircase. This allows cyclists to roll their bicycles up or down the staircase without having to carry it. Each ramp should be at least 10 inches (25 cm) wide to allow for pedal and crank arm width,.bicycle packs, etc. Especially if a wall is adjacent to the staircase. A concave ramp is preferred as it will help keep the bicycle wheels on the ramp.



A Stairway Bicycle Ramp

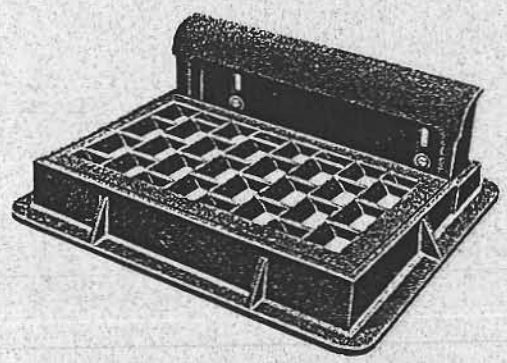
Figure 17-5

17.5 Bikeway Design

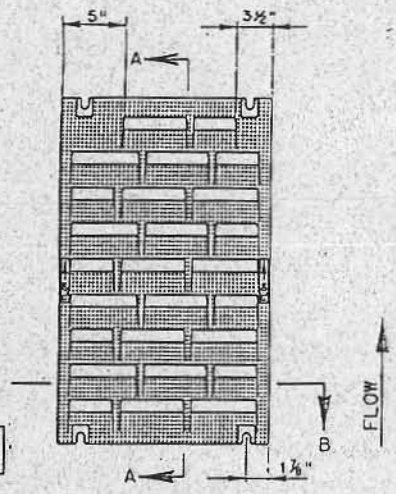
17.5.1 Roadway Improvements

17.5.1.1 Drainage Grates

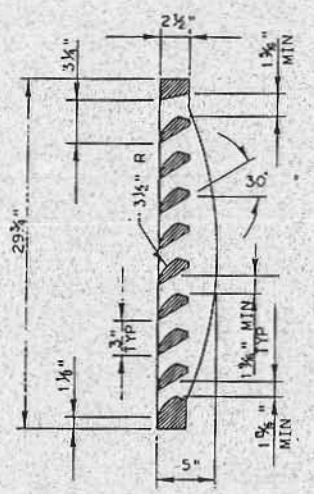
Drainage inlet grates and utility covers are potential problems to bicyclists. When a roadway is being resurfaced, it is important that grates and utility covers be adjusted to fit flush with the surface. Most parallel drainage inlet grates allow narrow bicycle tires to drop into the grates, which is extremely hazardous for cyclists and can be a liability. These and other hazardous grates should be replaced with bicycle-safe and hydraulically efficient grates. Vane grates are recommended. If a grate cannot be replaced it should be modified with bicycle-safe cross bars. When a new roadway is designed, all drainage grates and covers should be kept out of the bicyclists' expected path.



Grate shown is for flow-right condition.



PLAN
GRATE DETAIL



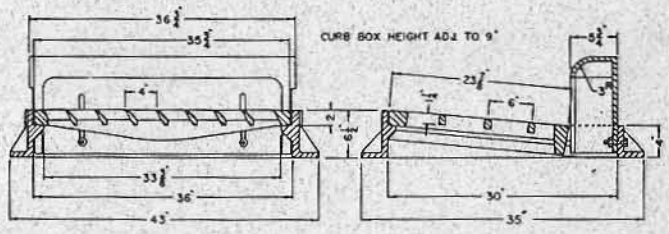
SECTION A-A

R-3246-AL Curb Inlet Frame, Grate, Curb Box

Heavy Duty Total Weight 640 Pounds

Specify:

1. If grate is to be used for flow-left or flow-right condition.



Bicycle-safe Vane Grates

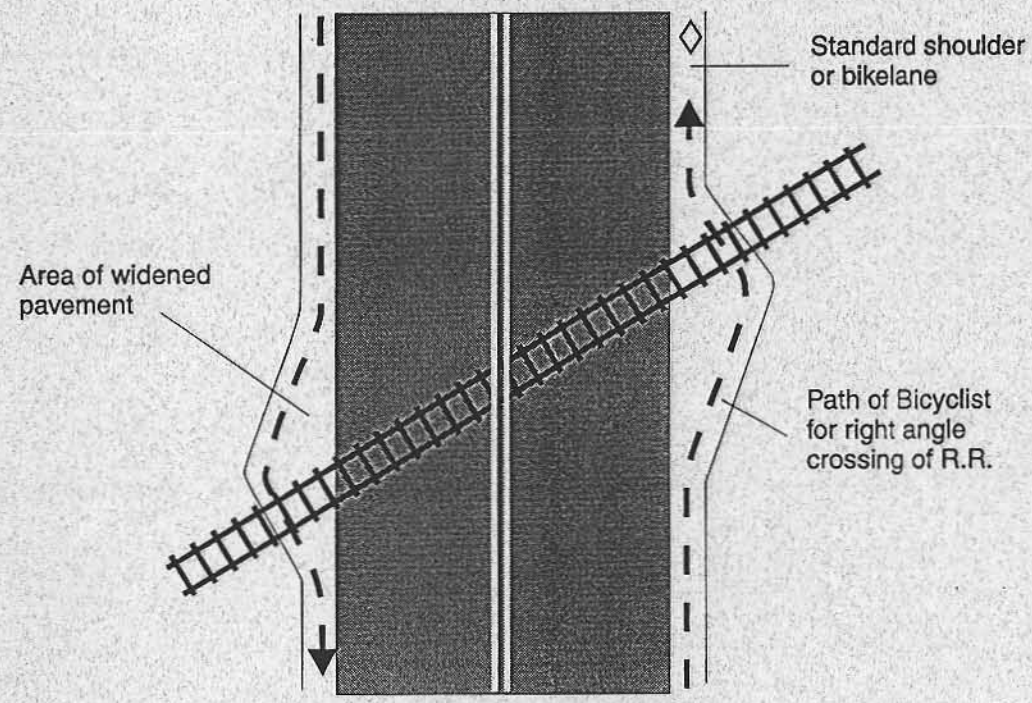
Figure 17-6

17.5.1.2 Railroad Crossings

Railroad-highway at-grade crossings should ideally be at a right angle to the rails, as the greater the crossing deviates from being perpendicular, the greater is the potential for a bicyclist's front wheel to be trapped in the flangeway. It is also important that the approach pavement be at the same elevation as the rails, including after overlays.

If the rails are more than 20 degrees out of perpendicular to the roadway, additional pavement width should be provided on the shoulder or bike lane to allow bicyclists to cross the tracks perpendicularly without conflicting with other vehicles. Where this is not possible, consideration should be given to the materials of the crossing surface and to the flangeway depth and width.

Rubberized crossings are the most preferable. Flangeway fillers can be used only on low-speed tracks such as industrial spurs, and not on high-speed main lines since they do not compress quickly enough to allow high-speed main line traffic. In some cases, abandoned tracks can be removed. When a crossing clearly poses a hazard to cyclists and cannot be improved, warning signs should be installed in accordance with the MUTCD.



Surface Widening for Bicycles at Non-Perpendicular Railroad Crossings

Figure 17-7

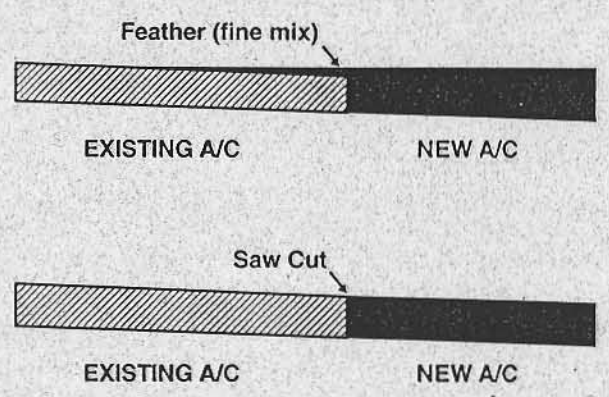
17.5.1.3 Pavement Surface Quality

Cyclists, particularly those riding on narrow, high-pressure tires, need to have relatively defect-free pavement in order to ensure control of their bicycles. As most road bikes do not have a suspension system, high-pressure tires transmit every bump to the rider. Cyclists are also susceptible to loss of control on deteriorated pavement with loose aggregates, potholes, litter, etc. Pavement seams parallel to the roadway should not be located on the portion of the road where bicycle use is expected. Utility covers and drainage grates should be flush with the pavement surface and should be adjusted with pavement overlays. (See Drainage Grates.) Approaches to railroad crossings should be improved as necessary to provide for safe bicycle crossings. (See Railroad Crossings.)

17.5.1.4 Pavement Structure

Pavement surfaces should be smooth, and the edge of the pavement should be uniform. Narrow slots in the surface that could catch a bicycle wheel, such as a gap in the longitudinal joint between two concrete slabs, should not be more than 1/2-inch (7 mm) wide. Ridges in the pavement that could cause cyclists to lose control, such as the joint between the pavement and a concrete gutter or utility cover, should not be more than 3/8-inch (9 mm) high when parallel to travel or 3/4-inch (19 mm) high when perpendicular to travel.

When overlaying pavement, the edge of the overlay should be matched to the height of the gutter or the gutter should also be overlaid. The full width of the shoulder should always be overlaid when overlaying the roadway surface. Also, if shoulders are to be added to a roadway to improve bicycling conditions, the added surface should be feathered or joined at a saw cut to create a smooth roadway to shoulder transition.



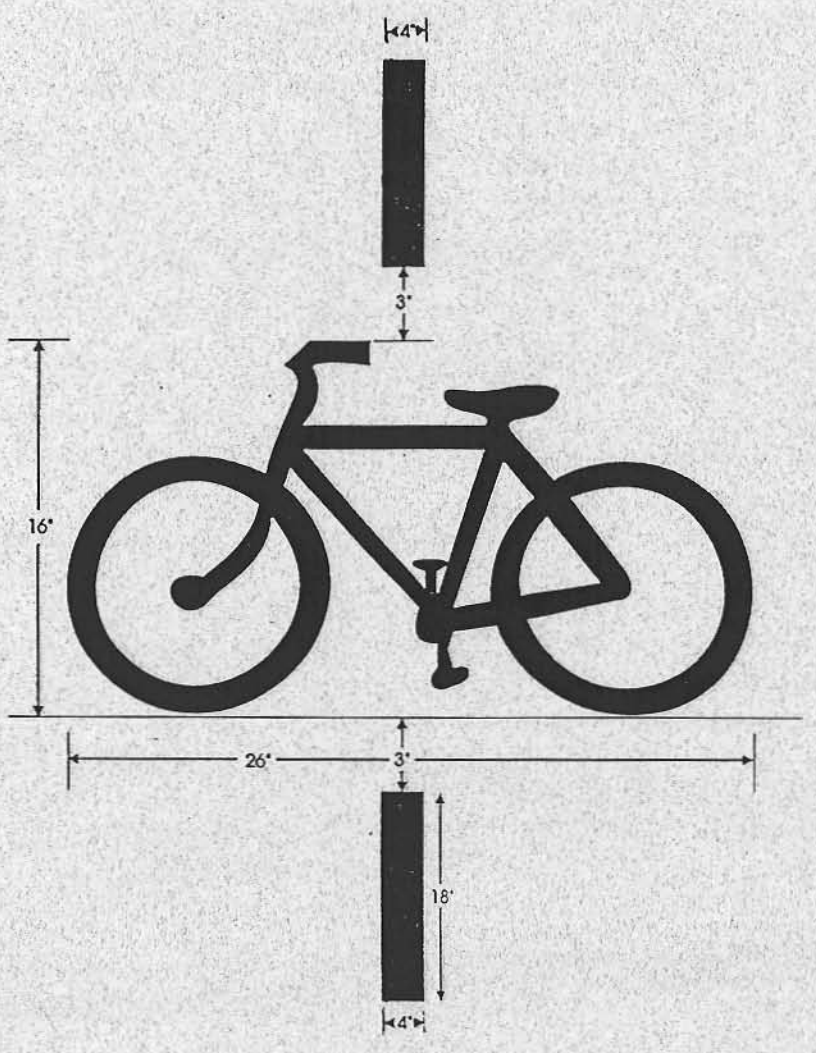
Added Surface Should be Feathered or Joined at Saw Cut

Figure 17-8

17.5.1.5 Traffic Control Devices

At signalized intersections where bicycle traffic exists or is anticipated, bicycles should be considered in the timing of traffic signal cycles and traffic detection devices. This includes left turn lanes, bike lanes, and standard travel lanes; anywhere a cyclist is expected to travel.

Reconstruction and new construction projects should include adequate bicycle detection. Loop and other detectors should be tuned and periodically returned to detect bicycles, particularly after a pavement overlay. Where programmed visibility signal heads are used, they should be checked to ensure that they are visible to bicyclists who are properly positioned on the road.



Placing the Bicycle Symbol Stencil in the Most Sensitive Area Over Signal Loops Allows Bicyclists to Trigger Signals in the Travel Lane or Bike Lane

Figure 17-9

Normally, a cyclist can travel through an intersection under the same signal phasing arrangement as motor vehicles; however, on multi-lane streets short clearance intervals should not be used. If necessary, an all-red clearance interval may be used. To check the clearance interval, a bicyclist's speed of 10 mph (16 km/h) and a perception/reaction/braking time of 2.5 seconds should be used.

The MUTCD should be consulted for guidance on signs and pavement markings. Where cyclists are expected to use different routings than motorists, directional signing should be used to confirm to cyclists that the special routing leads to their destination.

17.5.1.6 Wide Curb Lanes

On highway sections without bicycle lanes, a right lane of 14 feet (4.2 m) can better accommodate both bicycles and motor vehicles in the same travel lane. A lane width of 15 feet (4.6 m) of usable width is desired. (Usable width does not include gutter pan.) Where traffic speeds exceed 40 mph (64 km/h), and when ADT exceeds 10,000, 15 foot lanes are considered desirable. Because lanes greater than 15 feet wide (4.5 m) may encourage the undesirable operation of two motor vehicles in one lane, consideration should be given to striping a bike lane when wider widths exist. Wide curb-lanes are often the only improvement that is needed to *accommodate* cyclists, but striped bike lanes and designated facilities will *encourage* more bicycle use.

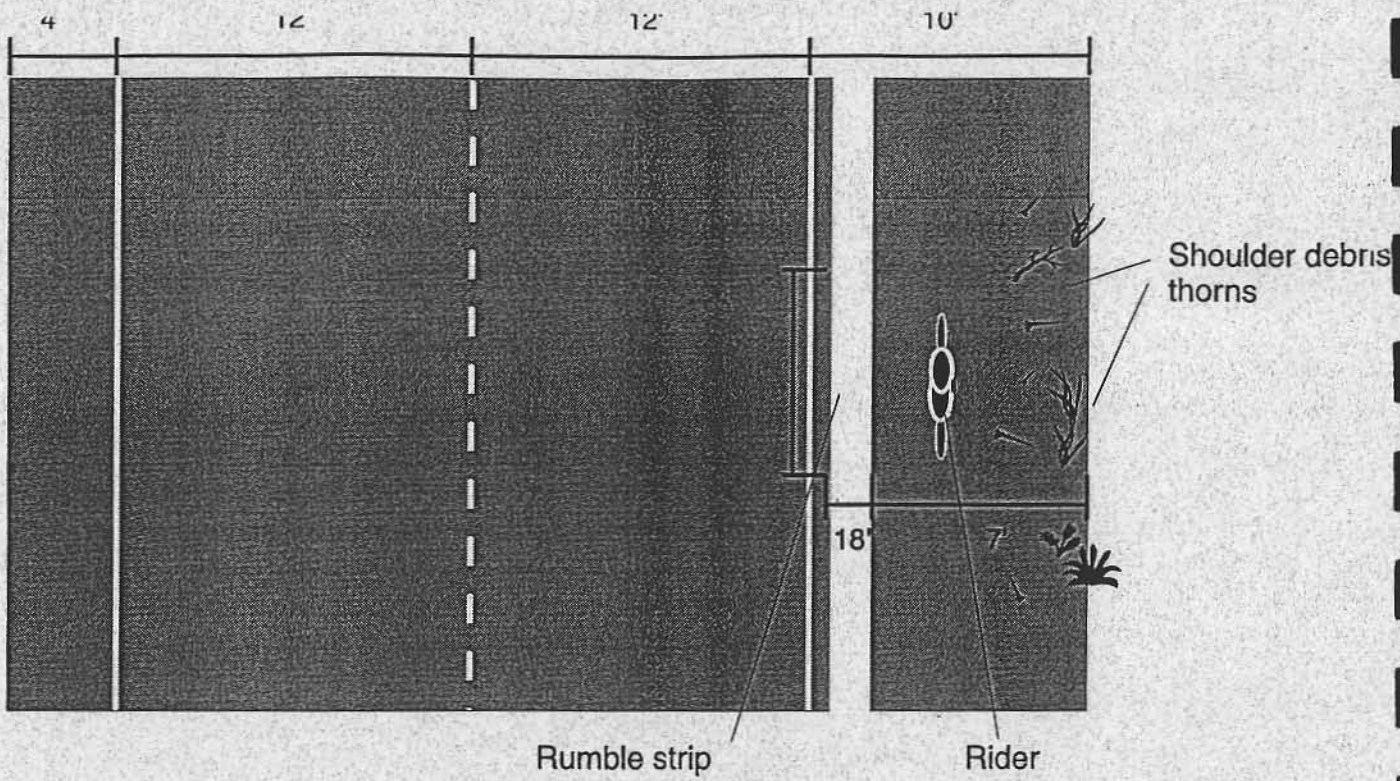
Wide curb-lanes can be created by widening roadways, by narrowing other traffic lanes, by eliminating parking, or a combination of the three. Restriping to provide wide curb lanes may be considered on some existing multi-lane facilities by making the remaining travel lanes and left turn lanes narrower. This should only be performed after careful review of present and projected traffic characteristics along the corridor. On-street parking has been shown to reduce roadway capacity and to increase the potential for crashes for all users, but elimination of parking should be carefully considered, and provided elsewhere if necessary.

17.5.1.7 Shoulders

A smooth paved shoulder should be provided and maintained on any highway where it is anticipated that cyclists will ride. Adding or improving shoulders can often be the best way to accommodate bicyclists in rural areas as they are also a benefit to motor vehicle traffic. (See Figure 17-10.) Where funding or right-of-way is limited, adding or improving shoulders on uphill sections is a priority, as slow-moving bicyclists need the added width to decrease conflicts with faster moving motor vehicle traffic. (See Canyon Improvements.)

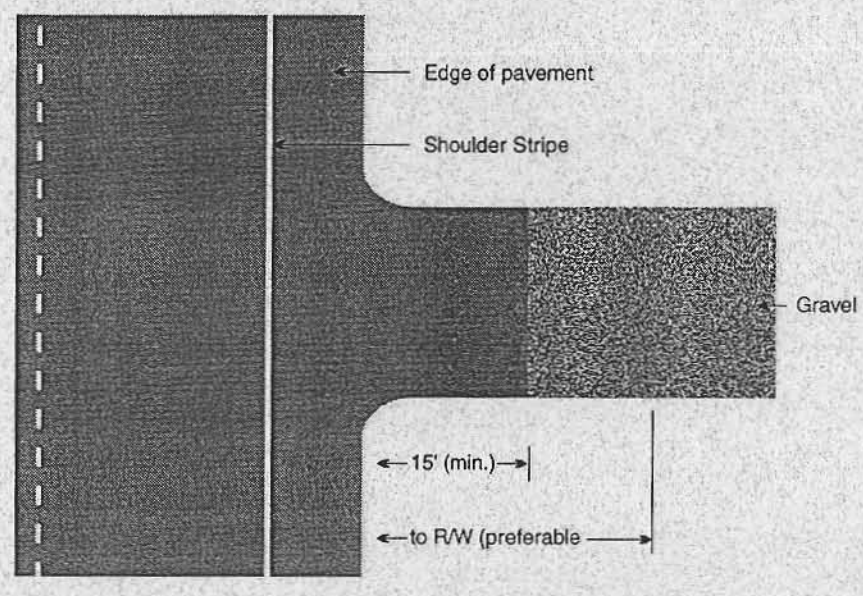
Shoulders without rumble strips shall be a minimum of 4 feet wide (1.2 m) to accommodate bicycle travel. Additional width is desirable if motor vehicle speed exceeds 35 mph (55 km/h), or the percentage of trucks, buses, and recreational vehicles is high, or static obstructions exist at the right side. A minimum of 6 ft. (2 m) should be used as a buffer from the wind blast effect of larger vehicles. Shoulders on bridges should have a minimum width of 6 ft. due to the buildup of debris and the trapped condition that cyclists face on them. Bridges that exceed a 3% grade should have a minimum shoulder width of 10 ft. (3 m).

Rumble strips can be a deterrent to cycling on shoulders. The best rumble strips are those that leave as much space for cycling to the right as possible. A minimum of 1 m of usable shoulder width shall be left for bicycling to the right. If rumble strips are used on asphalt highways, a continuous depressed rumble .6 m wide from the lane edge stripe is best.



Narrow, But Longer or Continuous Rumble Strips Provide a More Clean, Usable Shoulder for Bicyclists

Figure 17-10



Paved Aprons at Driveways and Intersections Prevent Gravel From Being Carried on to the Shoulder

Figure 17-11

17.5.1.8 Bike Routes

Urban bicycle routes must be located on the most direct path of travel that can adequately address safety concerns, and have as few cross route stops interrupting flow as possible. If bicyclists are required to make frequent stops, they will generally avoid the route or disobey the traffic controls on it. For this reason, when a bikeway is established on a minor street, consideration should be given to orienting stop signs to restrict cross traffic at most intersections, rather than on the bike route.

Generally, bicycle traffic will not be diverted to a less direct alternate route unless the favorable factors outweigh the inconvenience to the bicyclist. Roadway improvements, such as adequate pavement width, drainage grates, railroad crossings, pavement smoothness, maintenance schedules, and signals responsive to bicycles, should always be considered before a roadway is identified as a bicycle route.

Informational signage is important on all bike routes. It is often desirable to use supplemental plaques with bicycle route signs or markers to furnish additional information, such as direction changes in the route, intermediate range distance, and destination information. Directions to major destinations and activity centers or, at the minimum, general directions (north, south, east, west), should be signed for the cyclists' convenience. If a bike route heading in a particular direction jogs or meanders, destination and directional signage is an important reassurance.

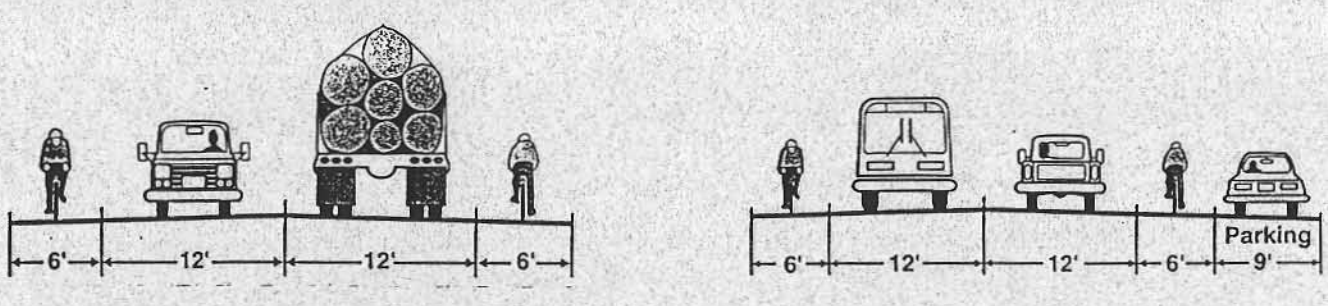
The MUTCD illustrates the standard signage and placement criteria to be followed in the signing of bicycle routes. Bicycle route signing should not end at a barrier. Information directing the bicyclist around the barrier should be provided. For long bicycle routes, a standard bicycle route marker with a numerical designation in accordance with the MUTCD can be used in place of a bicycle route sign. The number may correspond to a parallel highway, indicating the route is a preferred alternate route for cyclists.

17.5.1.9 Bike Lanes

Bicycle lanes should always be one-way facilities and carry traffic in the same direction as adjacent motor vehicle traffic. Two-way bicycle lanes on one side of the roadway are unacceptable because they promote riding against the flow of traffic. Wrong-way riding is a major cause of bicycle crashes, is illegal and, therefore, should be discouraged.

The minimum width of any bike lane should be 5 feet excluding the gutter pan (1.5 m) with wider lanes needed for certain situations. Additional widths are desirable when substantial truck traffic is present, on streets with parallel parking, on curves, or when vehicle speeds exceed 35 mph (55 km/h) etc..

The width of a bike lane is never calculated to include the gutter pan. Bike lane stripes should be placed so that if the pavement edge is uneven the bike lane will still be a consistent usable width.



Bike Lane Section Without Parking *Bike Lane Section With Parking*

Figure 17-12

When parking lanes are present, bike lanes should always be placed between the parking lane and the motor vehicle travel lane (see Figure 17-14). Bike lanes placed between the curb and the parking area create hazards for cyclists due to opening car doors, poor visibility at intersections, and maintenance difficulty. The minimum width for a bike lane adjacent to a parallel parking lane is 5 feet (1.5 m). If parking volume or turnover is high, an additional 1 or 2 feet (.3 or .6 m) of width is desirable.

Where parking is permitted but a parking lane is not provided, the combination lane intended for both motor vehicle parking and bicycle use should be a minimum of 12 ft. (3.7 m) wide. However, if it is likely the combination lane will be used as an additional motor vehicle lane, it is preferable to designate separate parking and bicycle lanes. In both instances, if parking volume is substantial or turnover is high, an additional 1 or 2 feet (0.3 or 0.6 m) of width is desirable for safe bicycle operation.

The typical width for a motor vehicle lane adjacent to a bike lane is 12 feet (3.7 m). There are situations where it may be necessary to reduce the width of motor vehicle lanes in order to stripe bike lanes. In determining the appropriateness of narrower motor vehicle lanes, consideration should be given to factors such as motor vehicle speeds, truck volumes, alignment, and sight distance. Where favorable conditions exist, motor vehicle lanes of 10 to 11 feet (3.0 to 3.4 m) may be appropriate for the accommodation of adjoining bike lanes.

Bike lanes are not advisable on long steep downgrades, where bicycle speeds greater than 35 mph (56 k/hr) are expected. As downgrades increase, downhill bicycle speeds increase, thereby increasing the danger of riding near the edge of the roadway. In such situations, bicycle speeds can approach those of motor vehicles, and experienced cyclists will generally move into the motor vehicle lanes to increase sight distance and maneuverability.

Bicycle lanes on a highway or road without curb or gutter should be located between the motor vehicle lanes and the roadway shoulders. When the shoulder is paved and there is sufficient width to accommodate both a minimum width bike lane and at least a two foot shoulder, it is unnecessary to stripe both a shoulder and a bike lane. Striping a wider shoulder is sufficient. A width of 5 feet (1.5 m) or greater is preferable. However, a minimum increase of 2 feet (.6 m) should be provided where substantial truck traffic is present, or where vehicle speeds exceed 35 mph (56 km/hr).

If bike lanes are to be located on one-way streets, they should normally be placed on the right side of the street. Bike lanes on the left side would cause cyclists and motorists to undertake crossing maneuvers in making left turns onto a two-way street. In some circumstances, however, bicycle lanes on the left side may be desirable if they reduce conflicts such as might occur with heavy bus traffic, multiple driveways, on-street parking, and high volumes of right turning motor vehicles. In either case, a bike lane should always be marked with a directional arrow to avoid confusion and should be consistent the length of the corridor.
Bike lanes tend to attract more cyclists than an unstriped bike route. Therefore additional measures such as pavement surface improvements, enhanced sweeping programs, bicycle-sensitive signal actuator (Figure 7-11), and upgraded street lighting, etc., that might not be possible on all streets should be implemented on roads with bike lanes. Raised pavement markings and barriers should never be used to delineate bicycle lanes because they present a hazard to bicyclists and are an obstruction to maintenance operations. Smooth or slick thermoplastic pavement markings should also be avoided, particularly where bicycle turning movements occur, because they are slippery, especially when wet.

Section 17.5.1.10 Tables for Selecting Roadway Design Treatments
The following Tables 1-3, show the best on-road bikeway type and width for various traffic volumes, highway classifications and situations. *From FHWA report " Selecting Roadway Design Treatments to Accommodate Bicycles," 1992.*

Table 1. Rural Road Section

average motor vehicle operating speed	annual average daily traffic volume (AADT)											
	less than 2,000				2,000 - 10,000				over 10,000			
	adequate sight distance	inadequate sight distance			adequate sight distance	inadequate sight distance			inadequate sight distance		adequate sight distance	
		truck, bus, rv.				truck, bus, rv.				truck, bus, rv.		
less than 30 mi/h	sh 4	**sh 4**	**sh 4**	sh 4	sh 4	**sh 4**	**sh 4**	sh 4	sh 4	**sh 4**	**sh 4**	sh 4
30 -40 mi/h	sh 4	**sh 4**	**sh 4**	sh 4	sh 4	**sh 6**	**sh 6**	sh 4	sh 6	**sh 6**	**sh 6**	sh 6
41 - 50 mi/h	sh 6	**sh 6**	**sh 6**	sh 6	sh 6	**sh 6**	**sh 6**	sh 6	sh 6	**sh 6**	**sh 6**	sh 6
over 50 mi/h	sh 6	**sh 6**	**sh 6**	sh 6	sh 8	**sh 8**	**sh 8**	sh 8	sh 8	**sh 8**	**sh 8**	sh 8

LEGEND: wc = *wide curb lane* sh = *shoulder* bl = *bike lane* na = *not applicable*

1 mi/h = 1.61 km/h

Table 2. Urban Section With Parking

average motor vehicle operating speed	annual average daily traffic volume (AADT)											
	less than 2,000				2,000 - 10,000				over 10,000			
	adequate sight distance	inadequate sight distance			adequate sight distance	inadequate sight distance			inadequate sight distance		adequate sight distance	
		truck, bus, rv.				truck, bus, rv.				truck, bus, rv.		
less than 30 mi/h	wc 14	**wc 14**	**wc 14**	wc 14	wc 14	**wc 14**	**sh 14**	wc 14	bl 5	**bl 5**	bl 5	bl 5
30 -40 mi/h	bl 5	**bl 5**	**bl 5**	bl 5	bl 5	**bl 6**	**bl 6**	bl 5	bl 6	**bl 6**	bl 6	bl 6
41 - 50 mi/h	bl 6	**bl 6**	**bl 6**	bl 6	bl 6	**bl 6**	**bl 6**	bl 6	bl 6	**bl 6**	bl 6	bl 6
over 50 mi/h	na	**na**	**na**	na	na	**na**	**na**	na	na	**na**	na	na

LEGEND: wc = *wide curb lane* sh = *shoulder* bl = *bike lane* na = *not applicable*

1 mi/h = 1.61 km/h

Table 3. Urban Section With No Parking

average motor vehicle operating speed	annual average daily traffic volume (AADT)											
	less than 2,000				2,000 - 10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		inadequate sight distance		adequate sight distance	
		truck, bus, rv.				truck, bus, rv.				truck, bus, rv.		
less than 30 mi/h	wc 14	**wc 14**	**wc 14**	wc 14	wc 14	**wc 14**	**wc 14**	wc 14	bl 5	**bl 5**	bl 5	bl 5
30 -40 mi/h	bl 5	**bl 5**	**bl 5**	bl 5	bl 5	**bl 6**	**bl 6**	bl 5	bl 5	**bl 6**	**bl 6**	bl 5
41 - 50 mi/h	bl 5	**bl 5**	**bl 5**	bl 5	bl 6	**bl 6**	**bl 6**	bl 6	bl 6	**bl 6**	**bl 6**	bl 6
over 50 mi/h	bl 6	**bl 6**	**bl 6**	bl 6	bl 6	**bl 6**	**bl 6**	bl 6	bl 6	**bl 6**	**bl 6**	bl 6

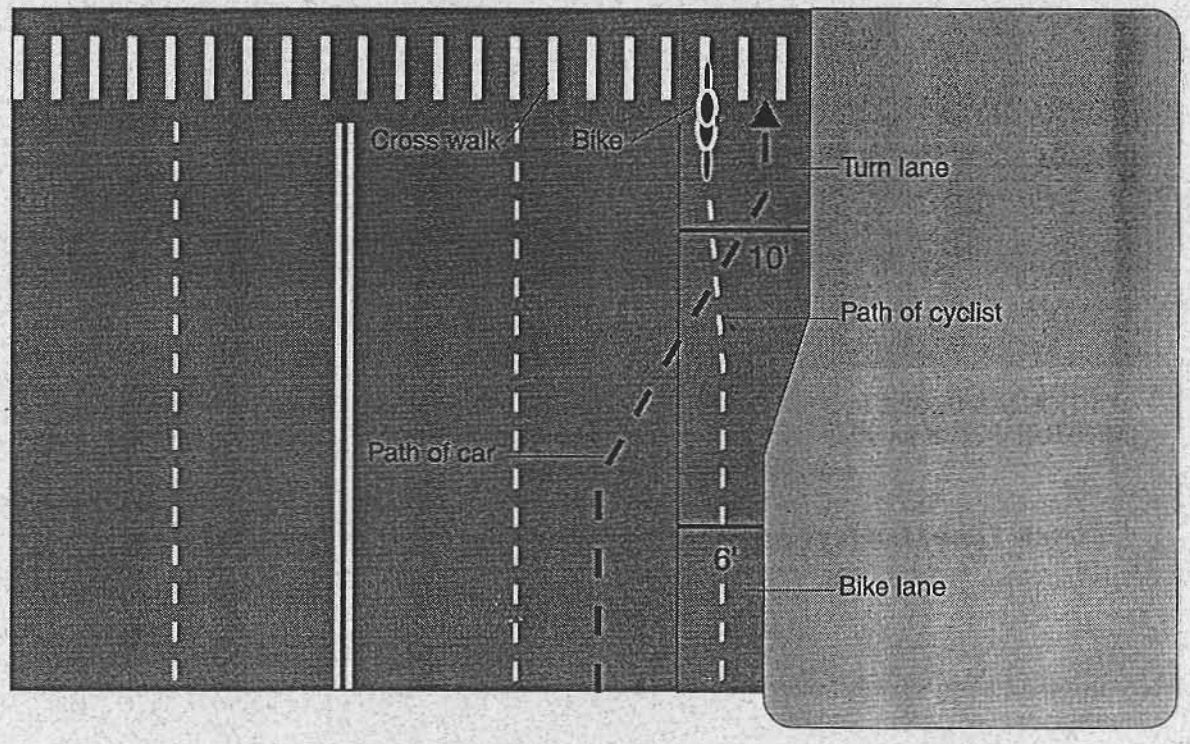
LEGEND: wc = *wide curb lane* sh = *shoulder* bl = *bike lane* na = *not applicable*

1 mi/h = 1.61 km/h

17.5.1.10 Intersections with Bike Lanes

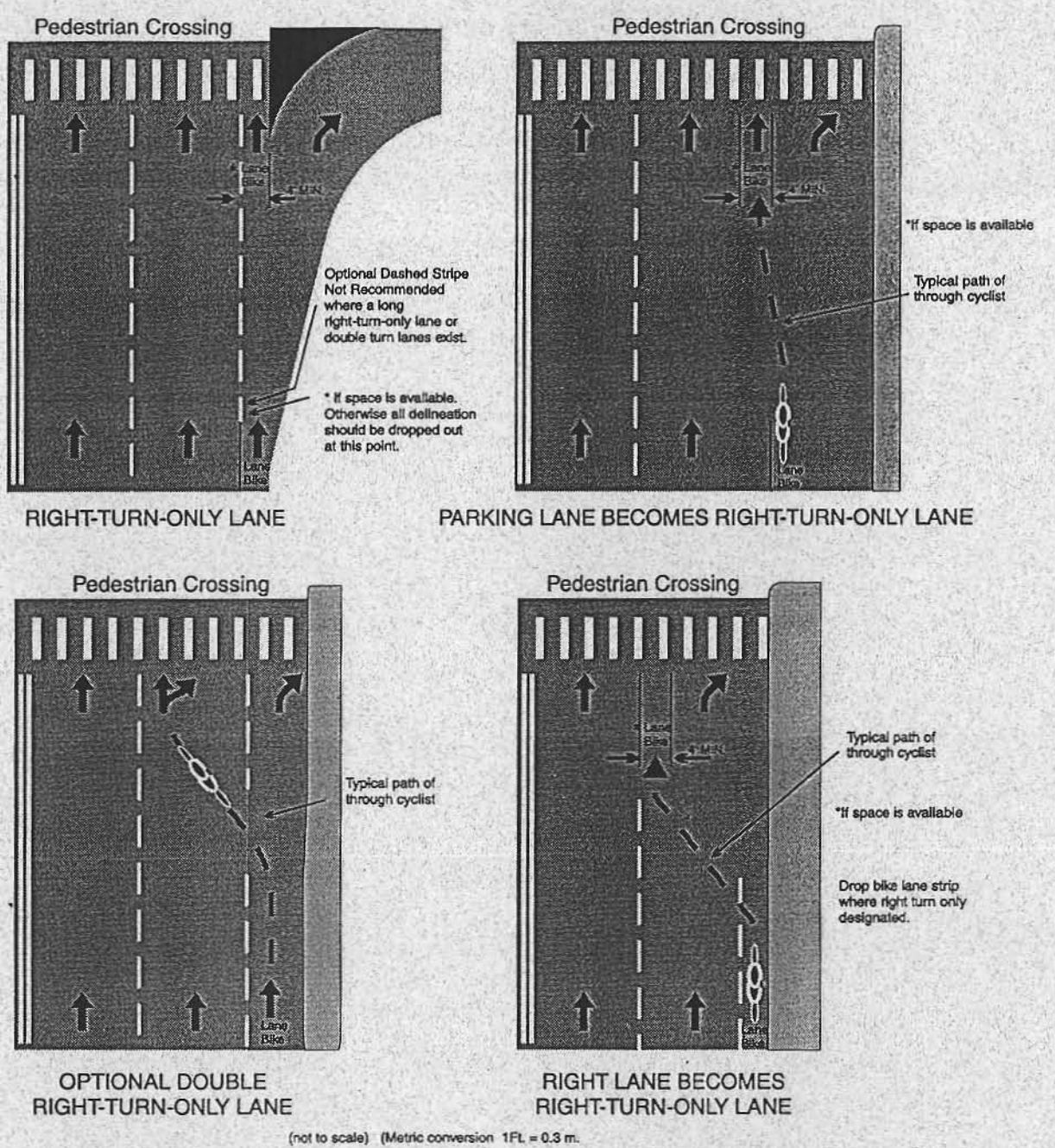
Because the greatest number of bicycle/motor vehicle conflicts occur at intersections, the design of bicycle lanes at intersections should be carefully considered. Bike lanes encourage bicyclists to keep right and motorists to keep left, somewhat discouraging both operators from merging in advance of turns. The design of bike lanes should include appropriate signing and marking at intersections to reduce the number of conflicts. Advance warning through signs or markings at locations where heavy cyclist conflicts are expected may alert motorists of the potential for cyclist-motorist conflict.

To avoid confusion, on minor and some major collectors it may be desirable to widen out the bike lane to 10 ft. (3 m) on final approach to an intersection, rather than to create a continuous right turn lane. This has the effect of inviting the motorist into the bicyclists' space, as opposed to forcing the cyclist out of the right portion of the roadway. This can be a safe practice due to the lower speed of turning traffic. The treatment should extend no more than a range of 75-100 ft. (23-30.5 m) in order to control the entering speed. In such a case, bicyclists intending to go straight may end up centered in the lane and thus will tend to momentarily block a right turning vehicle, although in actual practice this has minimal negative effect.



Shared Bicycle Lane/Right Turn Lane

Figure 17-13



Bicycle Lane Markings Approaching Motor Vehicle Right-Turn-Only Lanes

Figure 17-14

Traffic volume, design speed, and road width will dictate design. Clearly establish which user has the right-of-way, and provide the cyclist a straight and clear path through the intersection wherever possible. Traffic signals should be designed to respond to bicycles in the bike lane, or in the motor vehicle lanes if the bike lane is discontinued at the intersection. Striping and signal devices should correspond to MUTCD sections IX-B&C.

When providing markings for left turns at intersections, both options cyclists have in making left turns should be considered. Cyclists may use the left lane or the left turn only lane and turn as a motor vehicle. The cyclist may also turn as a pedestrian, proceeding to the far side of the intersection, then turning 90 degrees and crossing when the light changes. Where there are numerous left-turning bicyclists, a separate bicycle turning lane (as indicated in the MUTCD) should be considered.

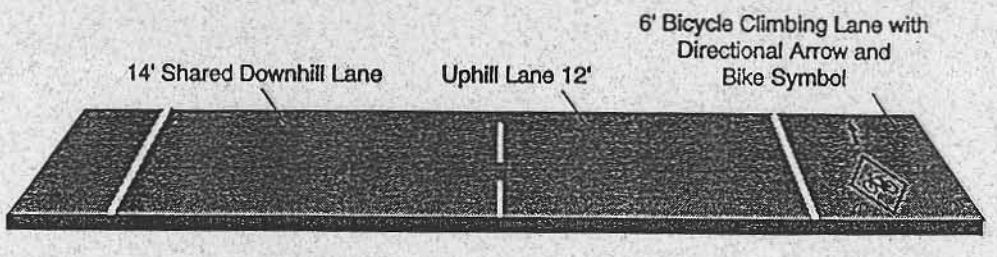
Since facilities are commonly installed on a project-by-project basis, bicycle lanes should be provided even for such short sections as an intersection improvement. If desired, the lane markings and signing can be left out until a longer facility can be connected. Designers should extend the bike lane portion of such intersection improvements into a logical merge location. This may require extending the normal length of the project several hundred additional feet.

Bike lanes should be discontinued at roundabouts. For one-lane roundabouts bike lanes shall end and permit a merge during the last 75 feet (23 m) of approach. No special markings are needed in the roundabout. Roundabout speeds shall be controlled through design at no more than 22 mph (14 km/hr).

17.5.1.11 Canyon Improvements

Canyons are a special attraction for avid cyclists, providing a challenging ride and pleasant scenery. Unfortunately, canyon roads can be narrow and winding with short sight distances. Some contain heavy truck or motor home traffic. Ascending cyclists are slow, but descending cyclists often travel as fast as motor vehicle traffic. For these reasons, canyon improvements afford special treatments.

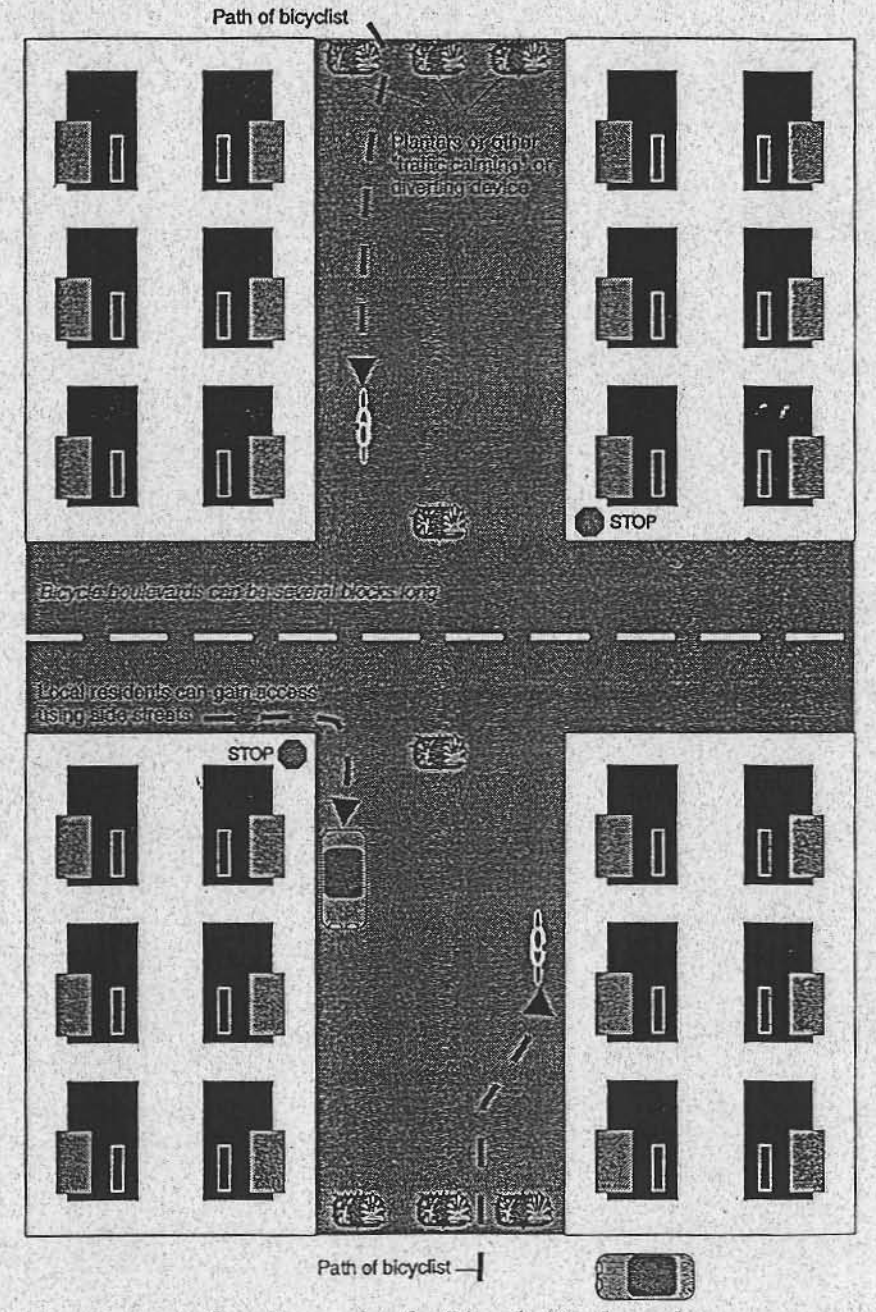
Uphill bicycle traffic should be provided a climbing lane-- a maintained shoulder or bike lane that has a minimum width of 4 feet (1.2 m). A wide outside lane is preferred for descending cyclists if a minimum 6 ft. (2 m) shoulder or bike lane cannot be provided. If a climbing lane is provided on the uphill, and no shoulder or bike lane is provided on the downhill, an uphill arrow pavement marking should be applied to the climbing lane in conjunction with the other bike lane symbols so that cyclists understand that the climbing lane is a one-way facility. Unless shoulders of 6 feet (1.8 m) or wider are located on the downhill, all turnouts on the downhill should be paved so that cyclists can safely pull over and let motorists pass if necessary.



Canyon Lane & Markings
Figure 17-15

17.5.1.12 Bicycle Boulevards

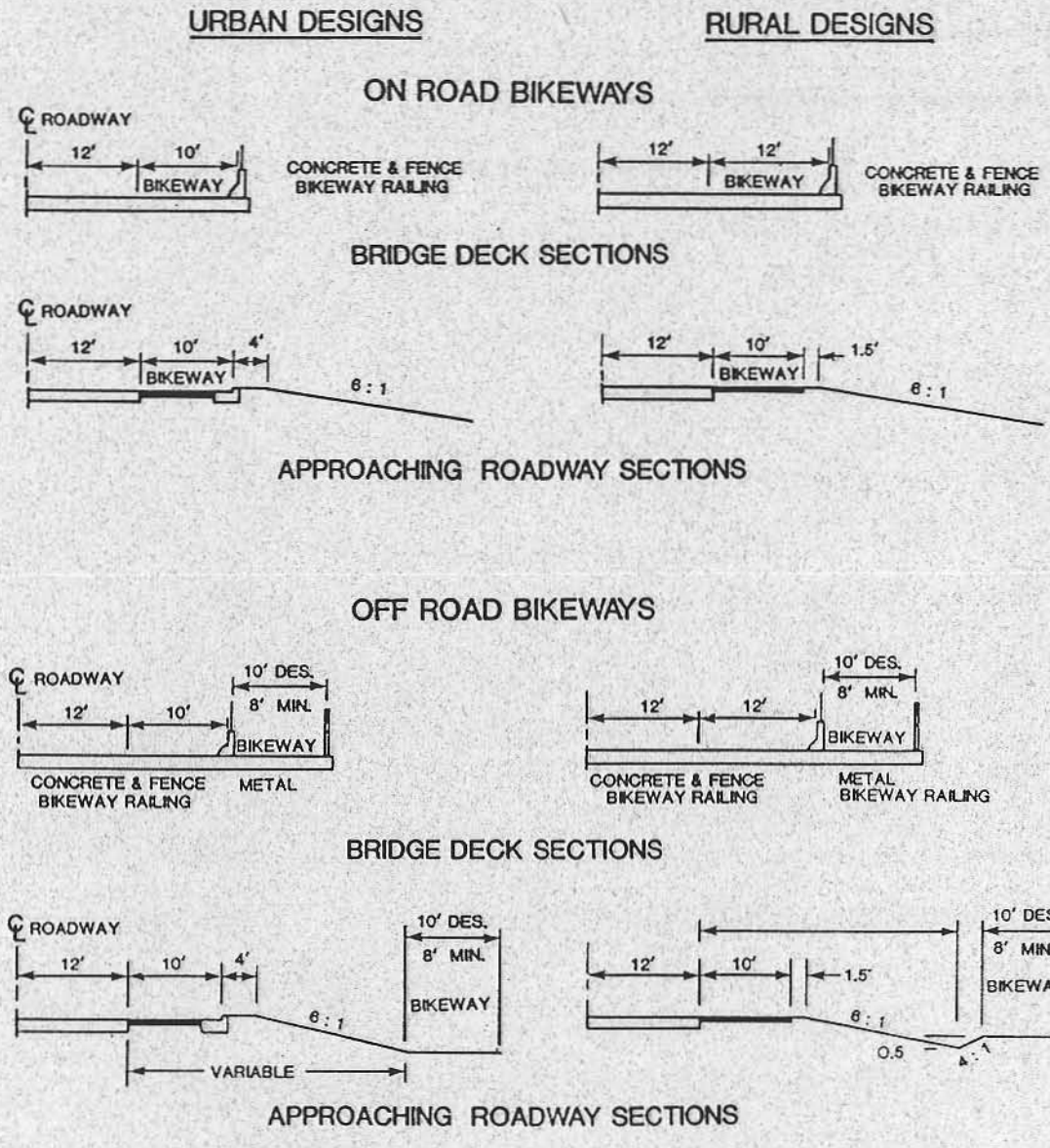
Bicycle boulevards are existing streets which are modified to serve as primary through routes for bicyclists. Because of a series of traffic controls which favor cyclists, through traffic by motor vehicles is prevented. Local residents may access the street from side streets. Roundabouts, planters, islands or other devices are used to slow or rechannel motor vehicles. Neighborhoods often like this solution as traffic volumes and speeds are lowered, making the street quieter and more liveable.



One Example of a Bicycle Boulevard
Figure 17-16

17.5.1.13 Bridge Approaches and Bridges

Bikeways at bridge approaches must be carefully coordinated with bikeways on bridges to make sure that all elements are compatible. Bicycle traffic bound in opposite directions is best accommodated by bike lanes, wide curb lanes, or shoulders on each side of a highway bridge, unless the approaching bikeway is an off-street two-way path on one side only. The usable width of the bikeway should be consistent between the approaches and the bridge. For more information consult CDOT Structures (Bridge) Manual.



Bridge Decks Designed With Bikeways

Figure 17-17

17.5.2 Off-Street Paths

17.5.2.1 Pavement Structure

The standard pavement is portland cement concrete with a transverse broom finish. One-half inch expansion joints shall be placed in the bikeway at intervals of not more than 500 feet (152.5 m). Contraction joints shall be spaced at 10 foot (3 m) intervals and shall be constructed to a depth 1/4 the slab thickness. The joints shall be saw cut 1/8" (.125 mm) wide between 4 and 6 hours after the concrete is poured. For rideability on new construction, the finished surface of bikeways should not vary more than 0.02 foot (.06 cm) from the lower edge of an 8 foot long straight edge when laid on the surface in any direction. Transverse joints shall be constructed by sawing to a minimum depth of 1/4 of the specified path thickness and a maximum width of 3/8" (9.5 mm).

Bituminous concrete is less suited for bicycle use due to its need for compaction and its susceptibility to root eruptions, but in situations where these conditions can be controlled and the use of portland cement is not possible, bituminous concrete may be acceptable. Other natural or recycled surface materials may be used if a narrow-tired road bicycle can travel the surface at 15 mph (9 km/hr) and wet weather conditions do not make it impassible due to puddling, mud, or other such degradation.

Because of wide variations in soils, loads, materials and construction practices, it is not practical to present specific or recommended typical structural sections that will be universally applicable. The Regional Materials Engineer should be consulted for each project to aid in making this determination. The Colorado Bicycle Program Manager should be notified if a material other than portland cement concrete is used.

17.5.2.2 Width and Clearance

Paths on which substantial bicycle volume, shared use with pedestrians and other non-motorized transportation and large maintenance vehicles, steep grades, and cycling two abreast should be 12 feet (3.7 m) wide. Otherwise, a 10 foot (3 m) width is adequate. A minimum 9 foot wide (2.7 m) path should be used only under the following conditions:

1. Bicycle traffic is expected to be low, even on peak days or during peak hours.

2. It is not a shared use facility (bikes only).

3. Horizontal and vertical alignment provides safe and frequent passing opportunities.

4. The path will not be subjected to maintenance vehicle loading conditions that would cause pavement edge damage.

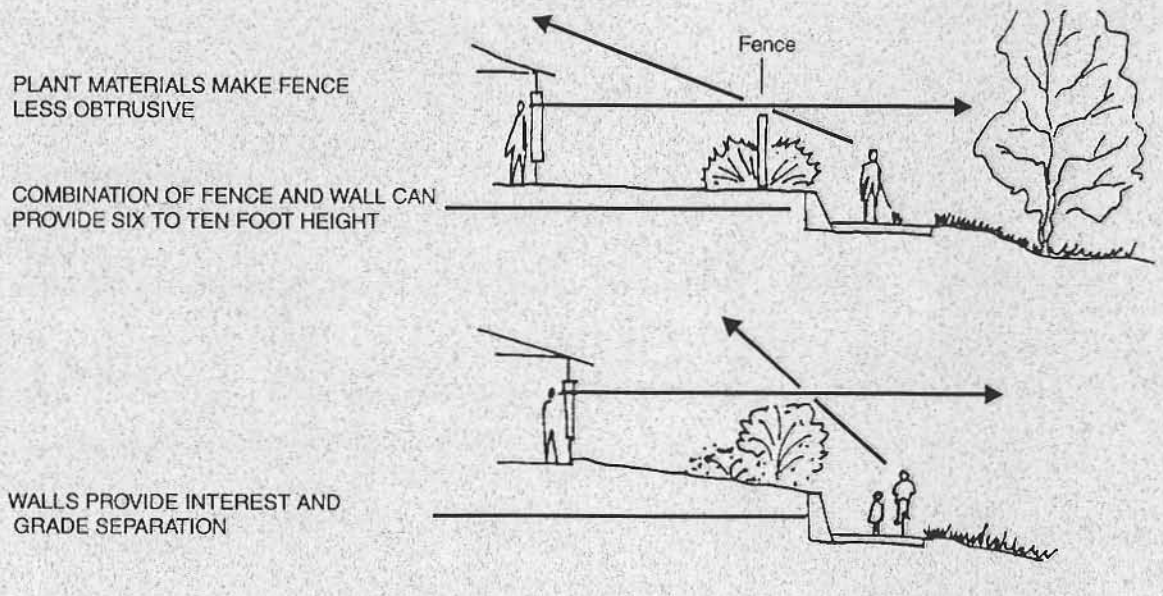
The minimum width of a one-directional bicycle path is 5 feet (1.5 m), with 8 feet (2.4 m) preferred for maintenance access and passing room for cyclists. One-way bicycle paths often

will be used as two-way facilities unless effective measures are taken to assure one-way operation.

A wide separation between bike paths and adjacent roadways is desirable. When this is not possible and the distance between the edge of the roadway and the bicycle path is less than 5 feet (1.5 m), a suitable physical divider should be provided. The divider shall be a minimum of 4.5 feet (1.4 m) high to prevent cyclists from toppling over it, and a maximum of 5 feet high to prevent sight distance obstruction. If high-speed motor vehicle traffic and curves exist on the roadway and there is no curb, a guardrail shall be used. Low shrubs may be used if a curb exists.

The optimum vertical clearance to obstructions is 10 feet (3 m) or higher, to accommodate maintenance, patrol, and emergency vehicle access. The standard vertical clearance is 8 feet (2.4 m). If a vertical clearance of 8 feet is not possible, the obstruction should be signed with black and yellow warning signs or a banner across the path posted at the height of the obstruction with the clearance posted on it. The minimum vertical clearance is 7 feet (2.1 m). ***Adequate access for emergency and maintenance vehicles should always be provided.***

An optimal 3-foot (0.9 m) wide graded area should be maintained adjacent to both sides of the pavement. A wider graded area on either side can serve as a separate jogging path. Two feet (0.6 m) is the minimum width for the adjacent graded area; although a 4-foot width clearance should be provided from trees, poles, walls, fences, guardrails, etc. or their lateral obstructions whenever possible. A 6-foot lateral separation is desirable from any embankment that the cyclist would have difficulty encountering. If this is not possible, a positive barrier such as dense shrubbery or a chain link fence shall be provided.



Path Design for Privacy
Figure 17-18

17.5.2.3 Design Speed

The speed at which a cyclist travels is dependent on several factors, including the type and condition of bicycle and the rider, the purpose of the trip, the condition and location of the bicycle path, grade, the speed and direction of the wind, and whether the cyclist is carrying any loads on the bicycle. Bicycle paths should be designed for a selected speed that is at least as high as the preferred speed of the faster cyclists. In general, a minimum design speed of 20 mph (32 km/h) should be used; however, when the grade exceeds 4 percent, or where strong prevailing tail winds exist, a design speed of 30 mph (48 km/h) is advisable.

On unpaved paths, where bicyclists tend to ride slower, a lower design speed of 15 mph (24 km/h) can be used. Similarly, where the grades or the prevailing winds dictate, a higher design speed should be used. Since bicycles have a higher tendency to skid on unpaved surfaces, horizontal curvature design should take into account lower coefficients of friction.
Speed bumps or similar surface obstructions intended to slow down cyclists should never be used.

17.5.2.4 Horizontal Alignment and Superelevation

The minimum radius of curvature negotiable by a bicycle is a function of the superelevation rate of the bicycle path surface, the coefficient of friction between the bicycle tires and the bicycle path surface, and the speed of the bicycle. The minimum design radius of curvature can be derived from the following formula:

$$R = \frac{V^2}{15\,(e+f)}$$

Where:
R = Minimum radius of curvature (ft)
V = Design speed
e = Rate of superelevation
f = Coefficient of friction

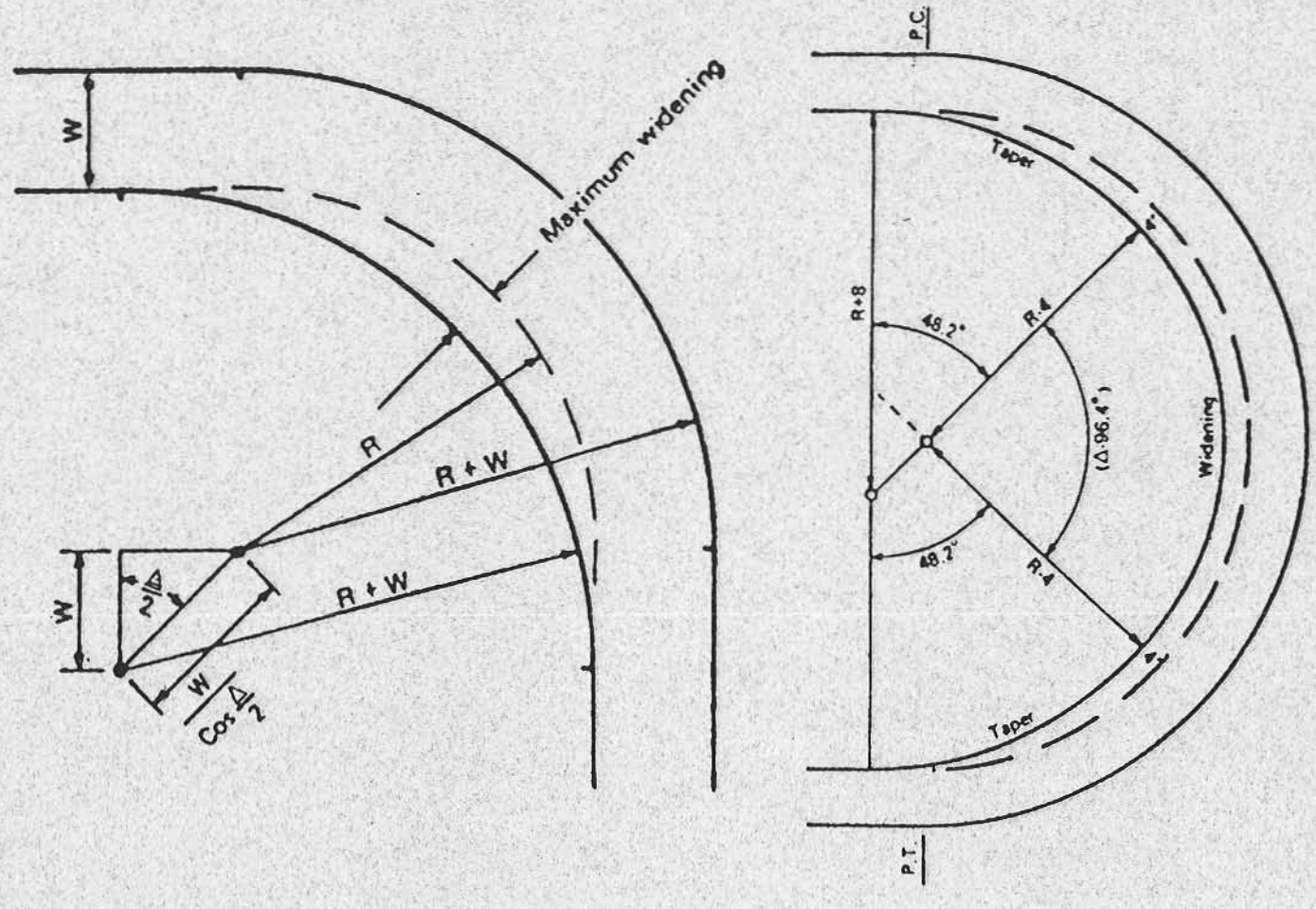
TABLE 1 Minimum Radii for Paved Bicycle Paths

Design Speed-V (mph) (1 MPH = 1.6 km/hr)	Friction Factor-f	Minium Radius -R (feet) (1ft. = 0.3 m)
20	0.27	95
25	0.25	155
30	0.22	250
35	0.19	390
40	0.17	565

For most bicycle path applications, the superelevation rate will vary from a minimum of 2 percent (the minimum necessary to encourage adequate drainage) to a maximum of approximately 5 percent (beyond which maneuvering difficulties by slow cyclists and adult tricyclists, etc., can be expected). The minimum superelevation rate of 2 percent will be adequate for most conditions and will simplify construction.

The coefficient of friction depends upon speed, surface type, roughness, and condition, type and tire condition, and whether the surface is wet or dry. Friction factors used for design should be selected based upon the point at which centrifugal force causes the bicyclist to recognize a feeling of discomfort and instinctively act to avoid higher speed. Extrapolating from values used in highway design, design friction factors for paved bicycle paths can be assumed to vary from 0.30 at 15 mph (24 km/hr) to 0.22 at 30 mph (48 km/hr). Although there is no data available for unpaved surfaces, it is suggested that friction factors be reduced by 50 percent to allow a sufficient margin of safety. Reduce friction factors by 50 percent in areas likely to be wet, shaded, exposed to minimal sun in winter, etc.

When substandard radius curves must be used on bicycle paths because of right of way, topographical or other considerations, standard curve warning signs and supplemental pavement markings should be installed in accordance with the MUTCD. It is advisable to widen the path in order to increase the lateral space available to cyclists as they lean to the inside of the turn (*see* Figure 17-19). The amount of widening should be limited to a maximum of 4 feet (1.2 m).



R = Radius of Curvature (from Figure 17-20)
W = Width of Bikeway
• = Central Angle of the Curve or Deflection Between Segments

Maximum Widening Shall Be Limited to 4 feet.

When Widening Reaches 4 ft. (• > 96.4•), That Width Shall be Carried on a Radius of R=4 Through the Central Portion of the Curve (• = 96.4•) as Shown.

Figure 17-19

17.5.2.5 Grade

Wherever possible, grades on bicycle paths should be kept to a minimum, especially on long inclines. A grade greater than 5 percent is undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent. Where terrain dictates, grades over 5 percent and less than 500 feet (152.5 m) are acceptable when a higher design speed or additional width is provided.

Sustained grades should be limited to 2 percent as much as possible if a wide range of riders is to be accommodated. Grades steeper than 3 percent may not be practical for bike paths with crushed stone surfaces. Grades of 6% are acceptable for bridges with 10 ft. (3 m) shoulders or paths where a leveling off at the base of the incline is provided which permits adequate recovery before an intersection or other conflict point. The maximum grade for a bike path is 9 percent. A path grade should not exceed 6% where handicap access is possible.

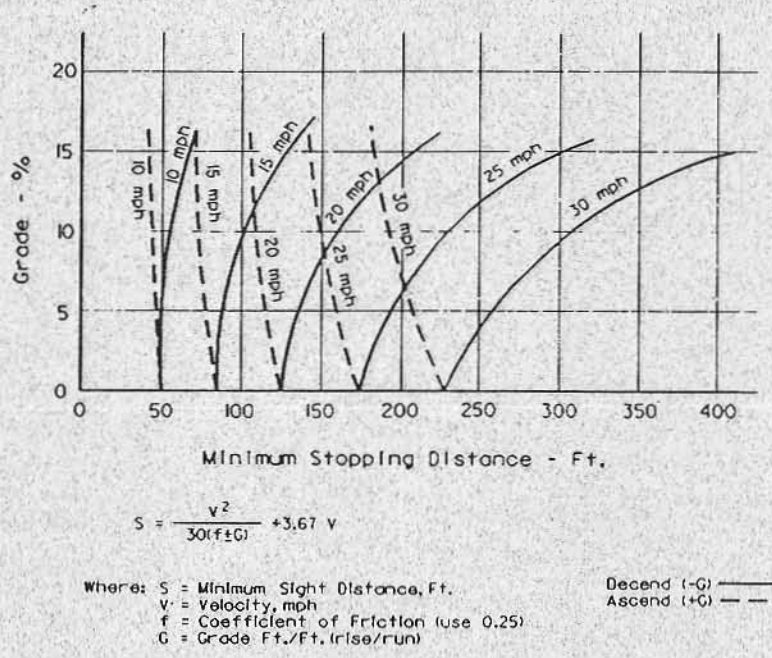


Figure 17-20

17.5.2.6 Sight Distance

To provide cyclists with an opportunity to see and react to the unexpected, a bike path should be designed with adequate sight distances. Sight distances should also be considered across the inside of horizontal curves.

Figure 17-22 indicates the minimum stopping sight distance for various design speeds and grades based on a total perception and brake reaction time of 2.5 seconds and a coefficient of friction of 0.25 to account for the poor wet weather braking characteristics of many bicycles. For two-way bicycle paths, the sight distance in descending direction, that is, where "G" is negative, will control the design.

Use Figure 17-21 to select the minimum length of vertical curve necessary to provide minimum stopping sight distance at various speeds on crest vertical curves. The eye height of the bicyclist is assumed to be 4.5 feet (1.4 m) and the object height is assumed to be zero as impediments to bicycle travel usually exist at pavement level.

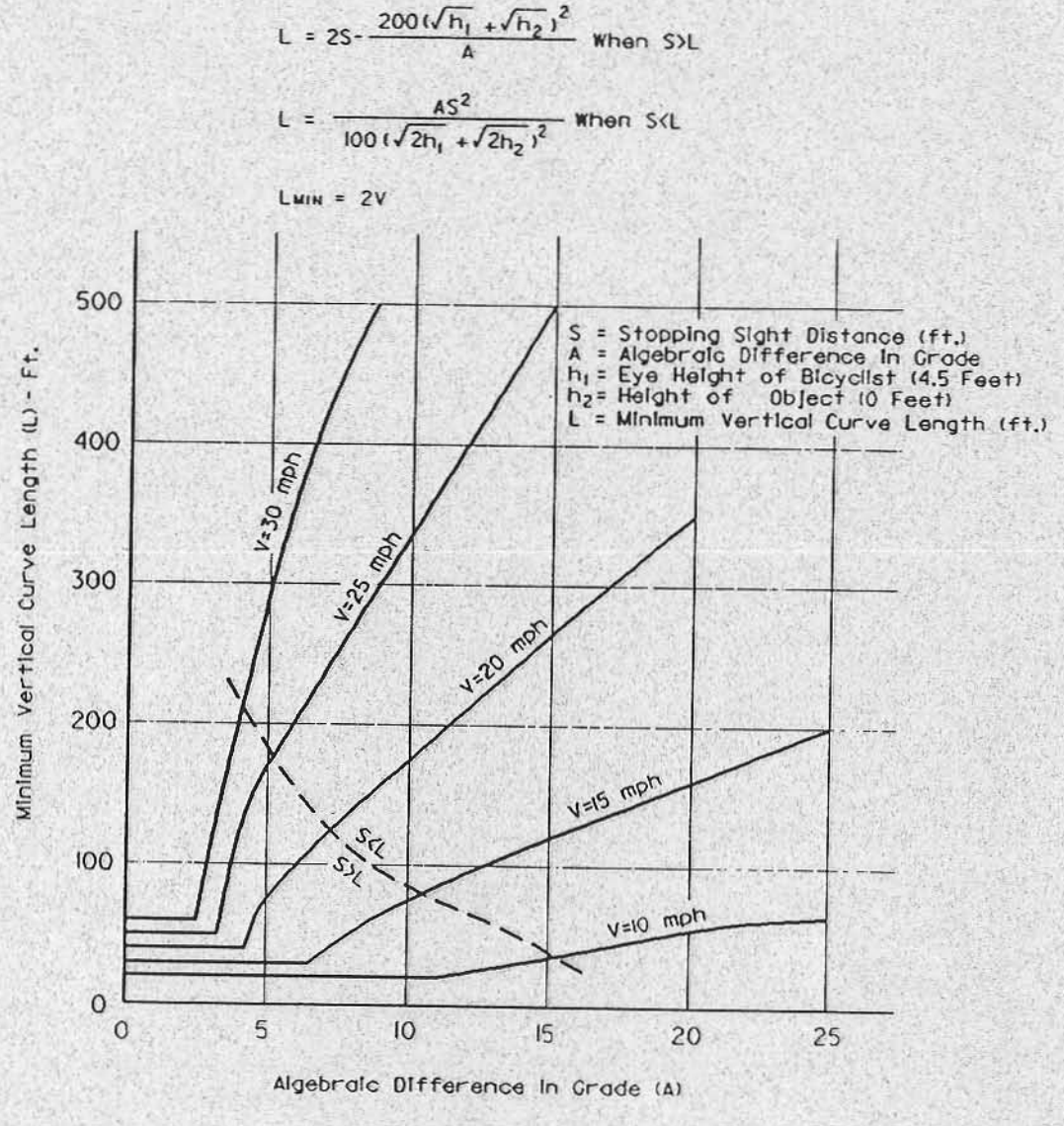
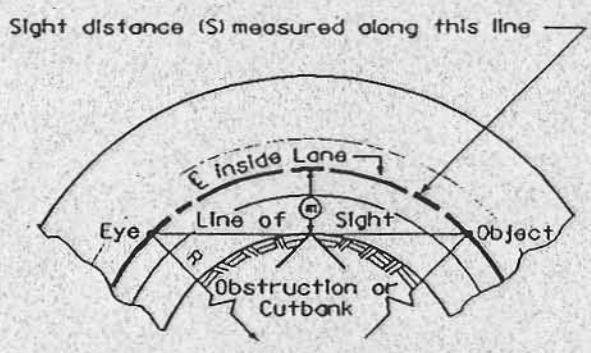


Figure 17-21

Figure 17-22 indicates the minimum clearance that should be used to line of sight obstructions for horizontal curves. The lateral clearance is obtained by entering Figure 17-23 with the stopping sight distance for Figure 17-20 and the proposed horizontal radius of curvature.



Line of sight is 2.0' above ℄ inside lane at point of obstruction.

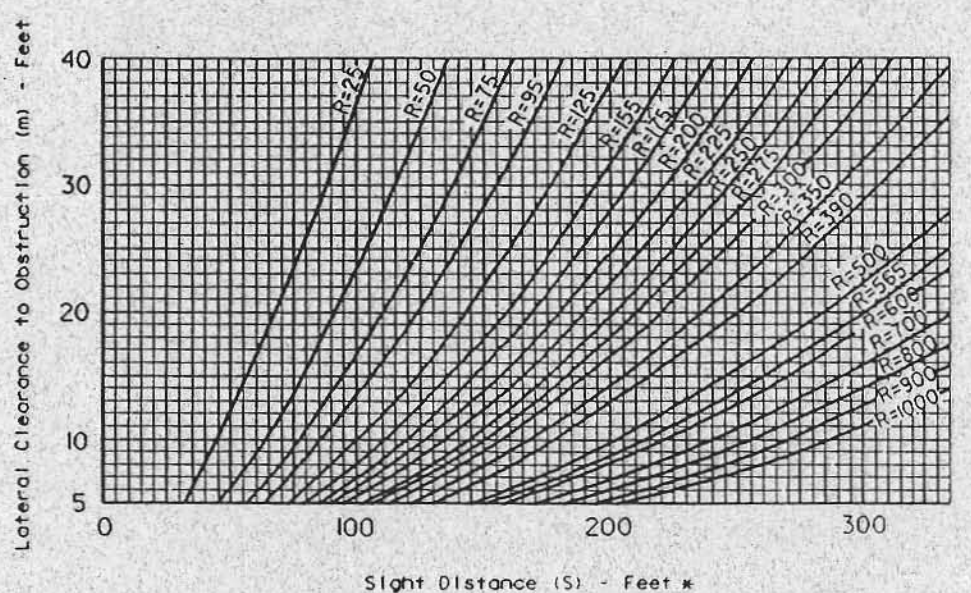
S = Sight distance in feet.
R = Radius of ℄ inside lane in feet.
m = Distance from ℄ inside lane in feet.
V = Design speed for S in mph

Angle is expressed in degrees

$$m = R\left[1 - \cos\left(\frac{28.65S}{R}\right)\right]$$

$$S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R-m}{R}\right)\right]$$

Formula applies only when S is equal to or less than length of curve.

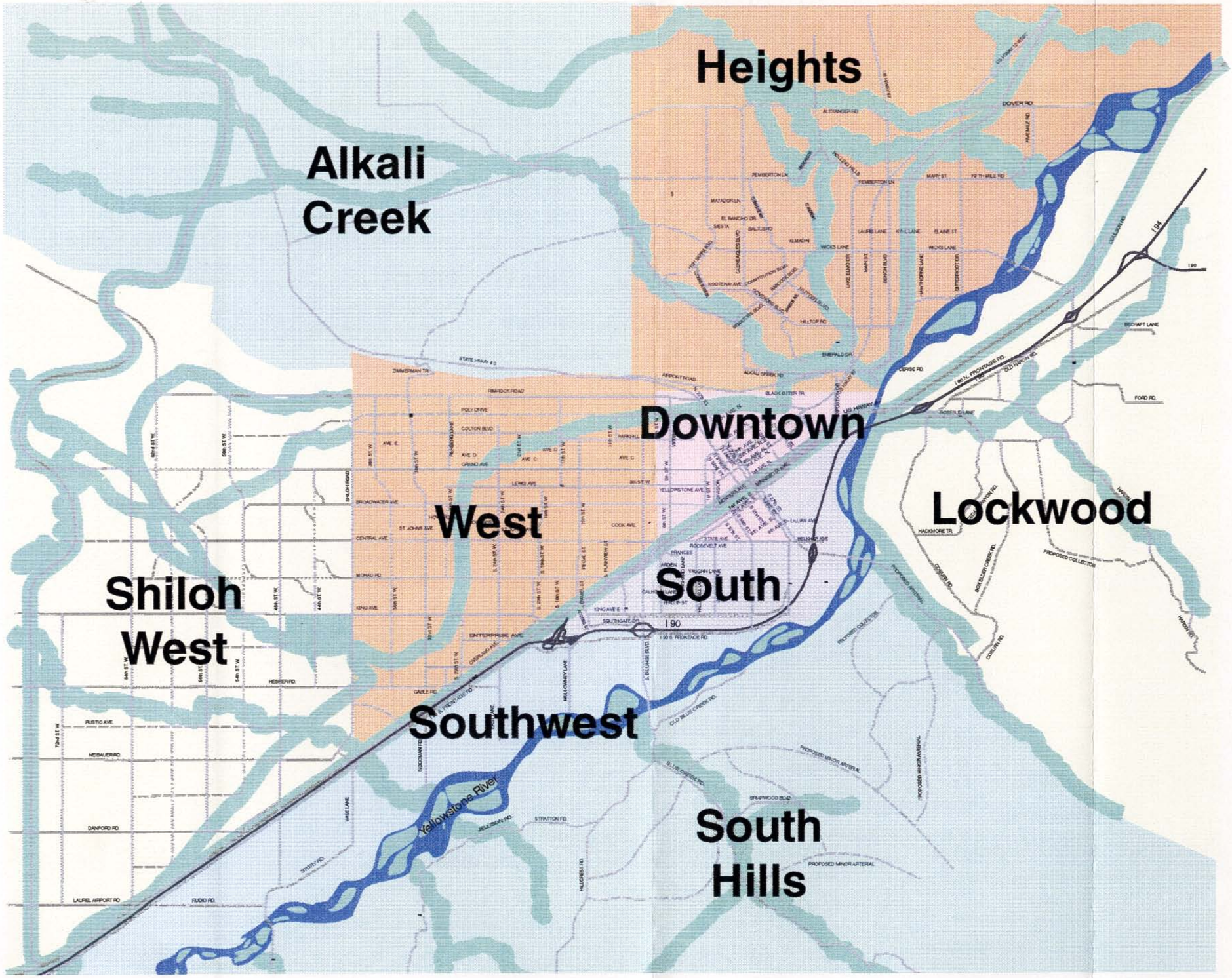


(Metric Conversion: 1 Ft. = 0.3 m.)

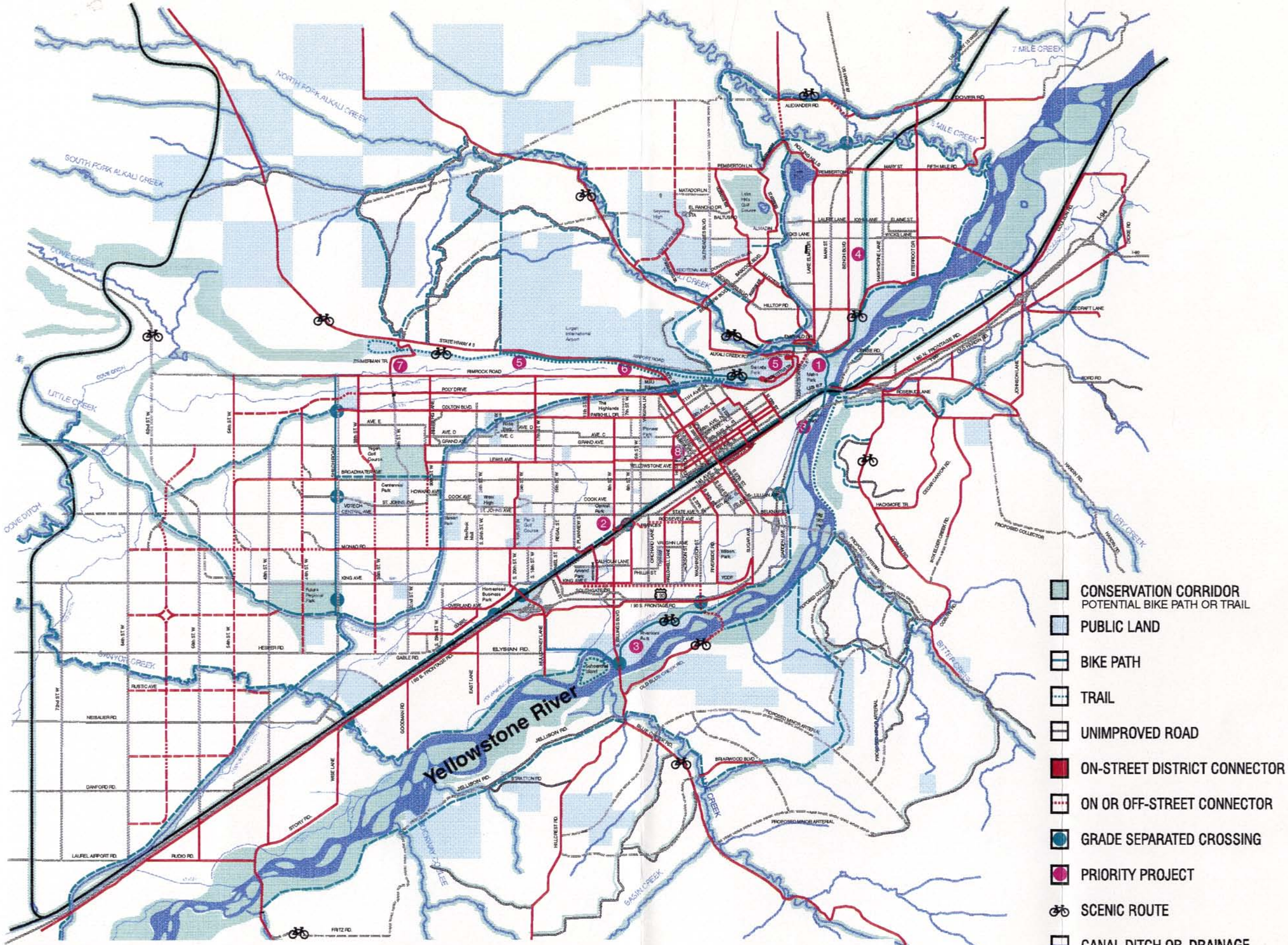
* Lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists travelling in opposite directions around the curve. See text for additional discussion.

Minimum Lateral Clearances on Horizontal Curves

Figure 17-22



Prepared By: Fischer & Associates - Landscape Architects and Land Planners Rev. December 8, 1994

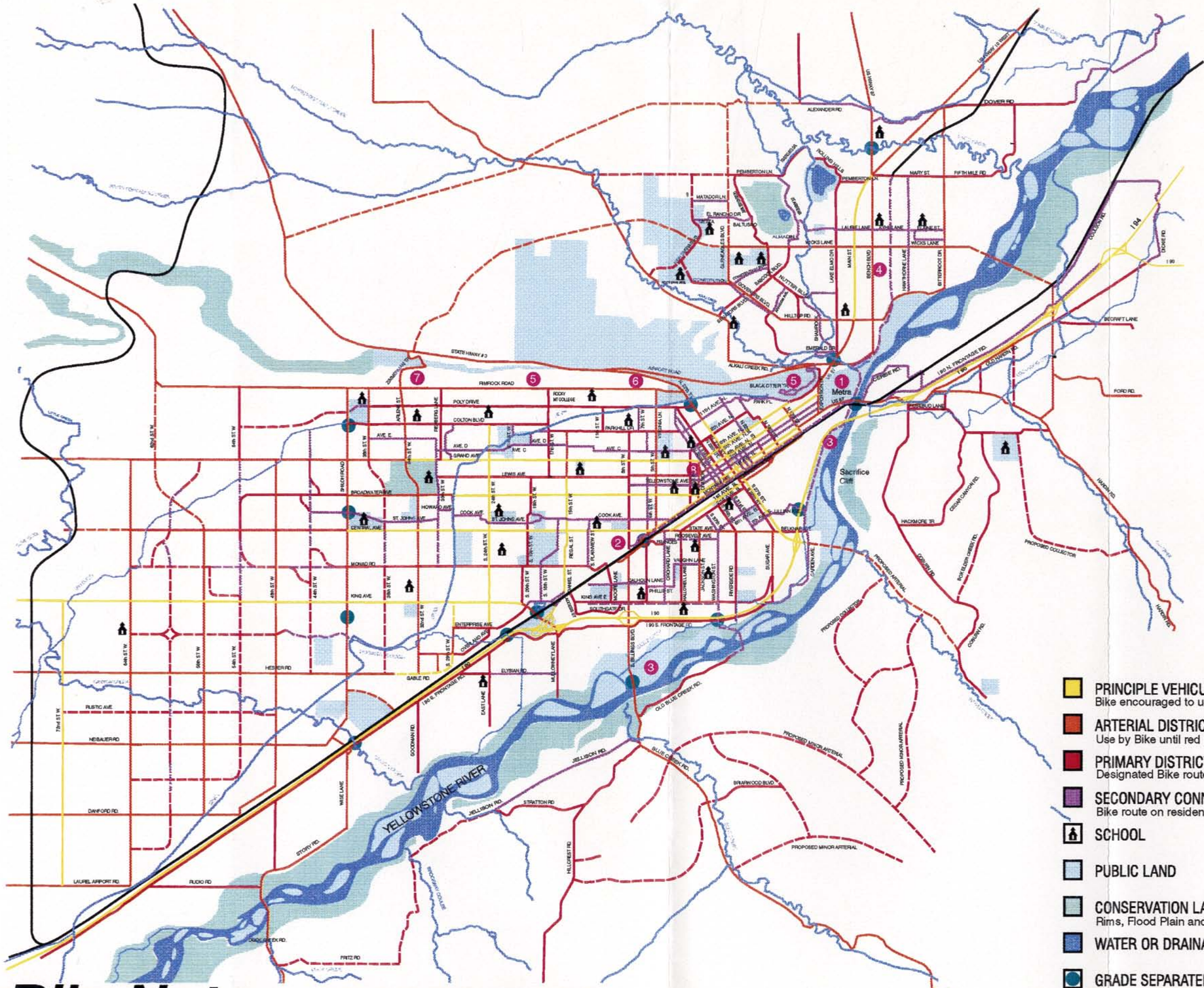


BikeNet OFF-STREET PLAN

Prepared By: Fischer & Associates - Landscape Architects and Land Planners Rev. December 8, 1994

- CONSERVATION CORRIDOR
  POTENTIAL BIKE PATH OR TRAIL
- PUBLIC LAND
- BIKE PATH
- TRAIL
- UNIMPROVED ROAD
- ON-STREET DISTRICT CONNECTOR
- ON OR OFF-STREET CONNECTOR
- GRADE SEPARATED CROSSING
- PRIORITY PROJECT
- SCENIC ROUTE
- CANAL DITCH OR DRAINAGE
- NATURAL DRAINAGE

NOTE: Dashed Indicates Proposed Streets



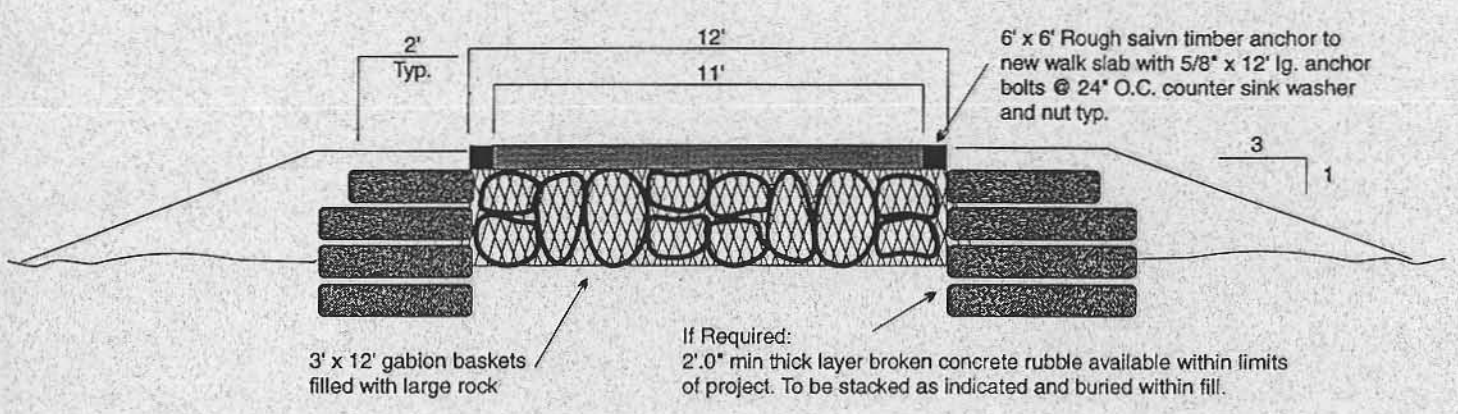
BikeNet ON-STREET PLAN

Prepared By: Fischer & Associates - Landscape Architects and Land Planners Rev. December 8, 1994

Cyclists frequently ride abreast of each other on bike paths. On narrow bike paths cyclists have a tendency to ride near the middle of the path. For these reasons, and because of the serious consequences of a head-on bicycle crash, lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for cyclists traveling in opposite directions around the curve. Where this is not possible or feasible, consideration should be given to widening the path through the curve, installing a non-skid yellow center stripe, installing a curve ahead warning sign in accordance with MUTCD, or a combination of these alternatives.

17.5.2.7 Drainage

Pavement and recovery zone cross slopes should be a minimum of 2 percent to provide for drainage. Sloping in one direction instead of crowning is preferred, and usually simplifies the drainage and surface construction and maintenance. An even surface is essential to prevent water ponding and ice formation. On curves the percentage should be increased to a maximum of 5 percent sloped in the direction of the inside of the curve, thus providing the semblance of superelevation. Culverts, other drainage and piping should be extended laterally at least 10 feet (3 m) from a pathway.



Flood Resistant Path Section.

Figure 17-23

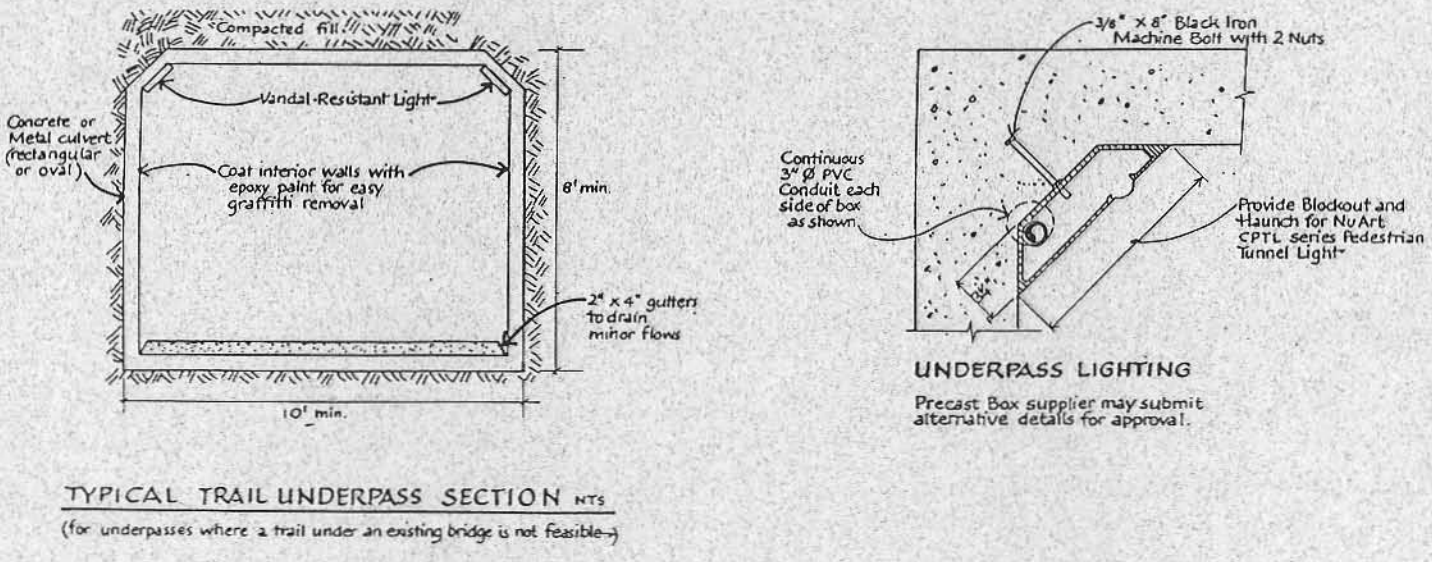
If a path is in a creek channel, the path should be designed and constructed for a minimum 2-year flood design frequency. A 5-year flood design frequency or above is optimum. Bridges should be engineered to allow the passage of the 10-year flood stage, with the 5-year stage as a minimum, or in accordance with local flood regulations.

Where a bike path is constructed on the side of a hill, a ditch of dimensions suitable for the safety of cyclists and for the volume of water expected should be placed on the uphill side to intercept the hillside drainage. Where necessary, catch basins with cross culverts should be provided to convey the intercepted water under the path. The length of cross culverts should be extended to include the clear zone as well as the path width, and should be backfilled to provide an uninterrupted clear zone. Drainage grates and manhole covers should be located outside of the travel path of bicyclists. To assist in draining the area adjacent to the bike path, the design should include considerations for preserving the natural ground cover. Seeding, mulching, and sodding of adjacent slopes, swells, and other erodible areas should be included in the design plans.

Where the bikeway will pass underneath highway bridges, existing deck drain discharges should be routed so that deck runoff will not discharge upon or flow across the bike path. Deck drainage can create ice and algae on the pavement as well as erode the pavement surface.

17.5.2.8 Lighting

Lighting for bicycle paths is important and should be considered where riding at night is expected, such as bike paths serving college students or commuters, and at highway intersections. Fixed-source lighting reduces conflicts along paths and at intersections. In addition, lighting allows the cyclist to see the bike path alignment, surface conditions, and obstacles. The lights of oncoming traffic will shine directly at bicyclists causing momentary blindness that can be hazardous on a curving path or in the face of oncoming bicycle traffic. In this case low level path lighting is recommended.



Underpass Section Showing Placement of Vandal-Resistant Lighting

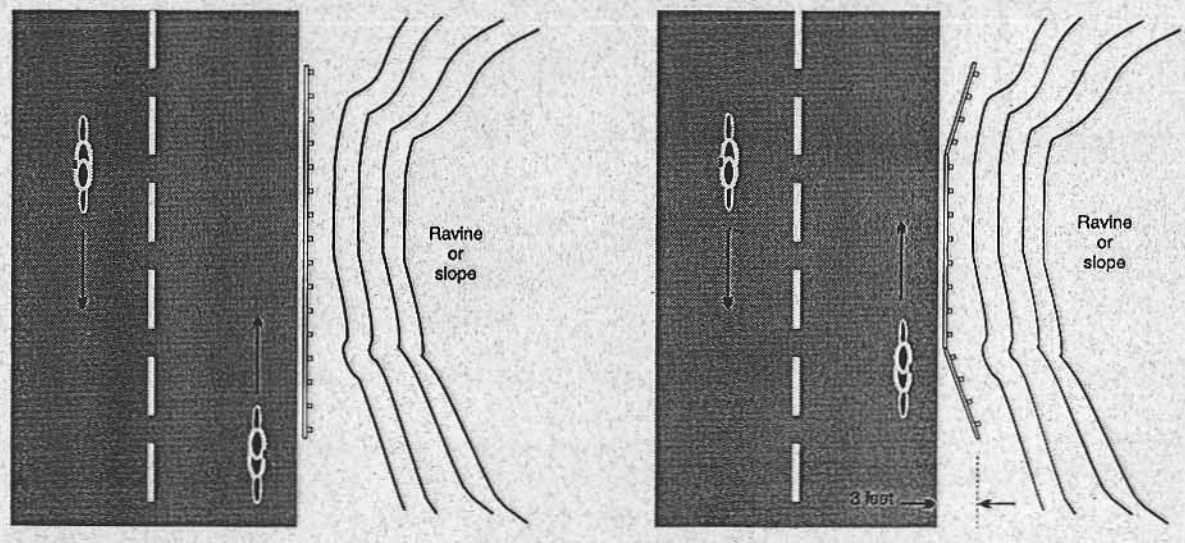
Figure 17-24

All intersections should be lit far enough back from the intersection in order to allow the cyclist and the motorist enough time to see the intersection and react appropriately. Lighting should be provided through underpasses or tunnels where nighttime security could be a problem. Underpasses which are particularly dark during the daytime should also be lit continuously for personal safety reasons and to avoid possible hazards. Lighting should also be provided wherever there is signage, particularly at warning signs.

Depending on the location, average maintained horizontal illumination levels of 0.5 foot-candle to 2 foot-candles should be considered. Illumination levels under short bridges should be enhanced comparable to daytime illumination levels at tunnel entrances. Where special security problems exist, higher illumination levels may be needed. Light standards should meet the recommended horizontal and vertical clearances. Luminaries and standards should be at a scale appropriate for a pedestrian or bike path, and compatible with maintenance vehicle access capabilities regarding mounting heights. Vandal-proof lighting shall be used.

17.5.2.9 Bike Path Safety Railings at Embankments

Railings are recommended in situations where bicyclists or pedestrians may fall down an embankment or other vertical displacement. Railings, fences or barriers on either side of a bike path structure should extend 4.5 feet (1.4 m) higher than the bike path and have smooth rub rails attached at handlebar height-- 3.5 feet (1.1 m), which are made of smooth metal or a similar material. It is required that railing ends be flared away from the path at either end of the railing to prevent cyclists and pedestrians from catching on the railing.



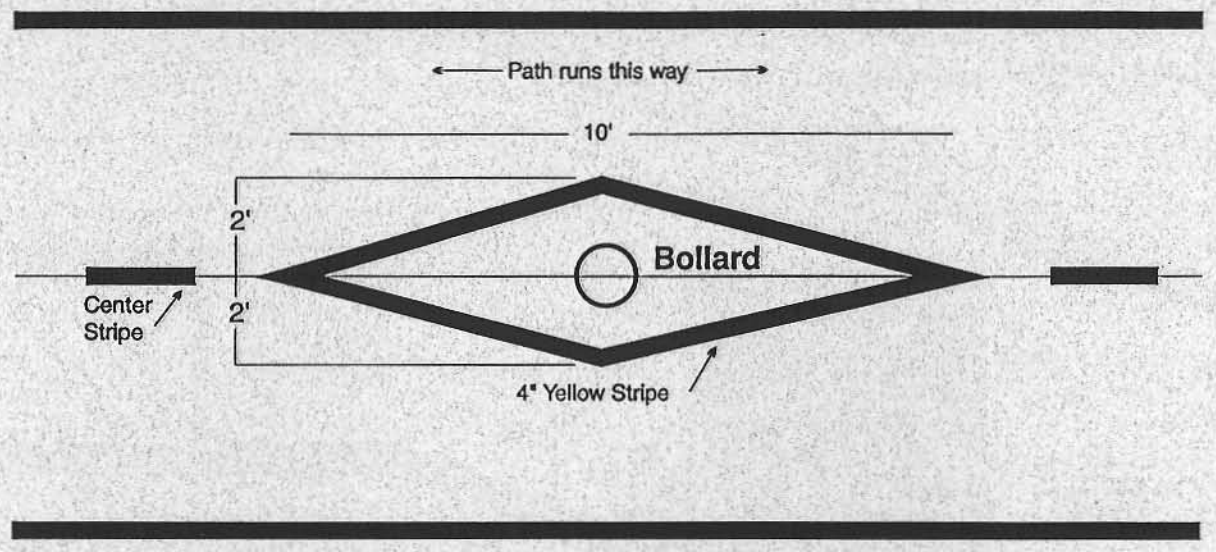
A) If the end of the fence is too close to the path, cyclists may hook it with their handlebars.

B) The lateral clearance should narrow gradually in a hazzard approach zone.

Flare Ends of Path Safety Railings

Figure 17-25

day or night. Striping around the barriers is recommended. Where more than one post is necessary, a 5-foot (1.5 m) spacing should be used to permit passage of bicycle-towed trailers and adult tricycles, and to assure adequate room for safe bicycle passage without dismounting.



Bollard Striping

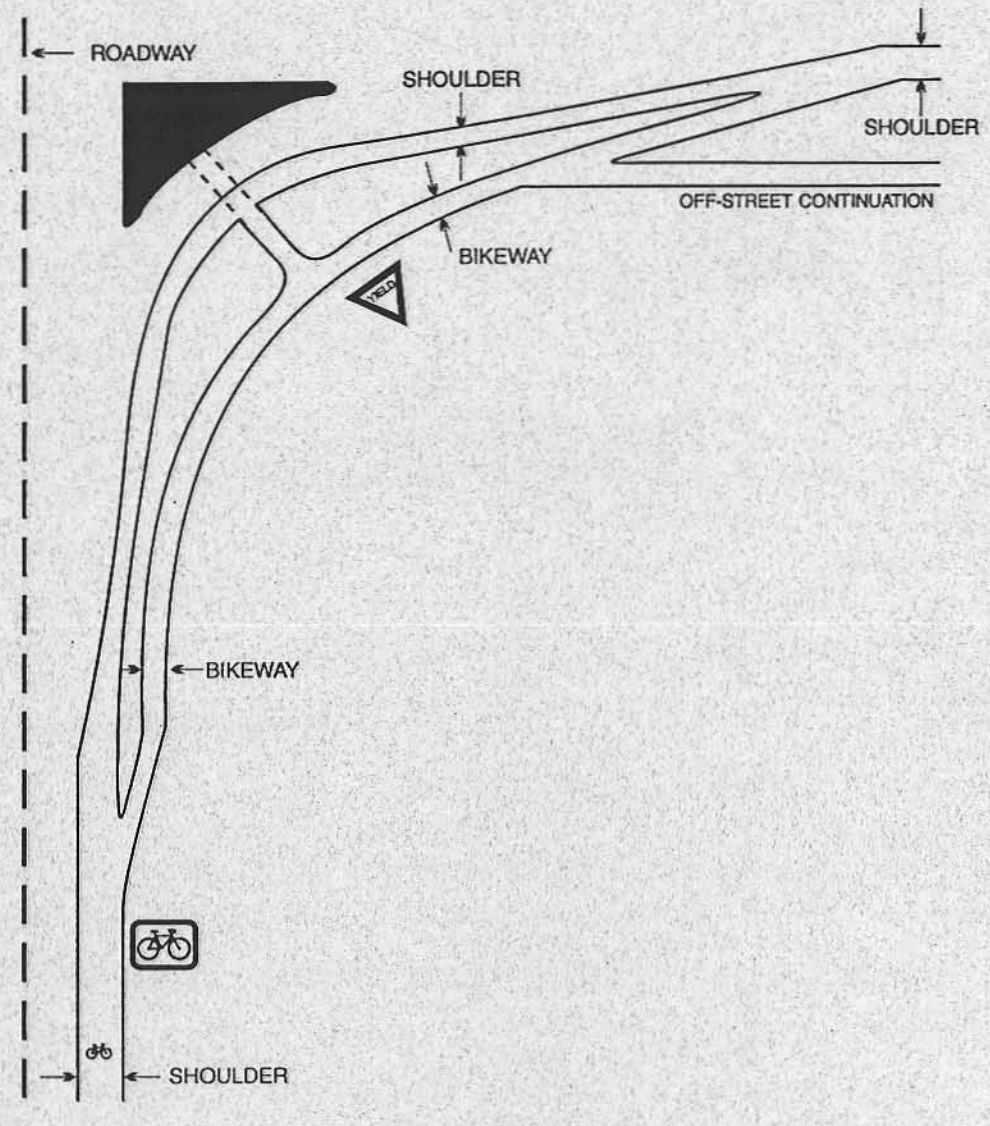
Figure 17-28

17.5.2.11 Bike Path/Roadway Intersections

Bike path intersections with roadways are one of the most important safety considerations in bike path design. If alternate locations for a bike path are available, the one with the most favorable intersection geometries and overall intersection layout should be selected. Bike path intersections and approaches should be on relatively flat grades. Stopping sight distances at intersections should be checked and adequate warning should be given to permit cyclists to stop before reaching the intersection, especially on downgrades. Ramps for curb cuts at intersections should be the same width as the bike paths. Curb cuts and ramps should provide a smooth transition between the bike paths and the roadway.

Freeway at-grade crossings pose special hazards to bicyclists due to the high-speed entry and exit conditions, long tapers, and the expansive roadway crossing widths. Bicyclists can be aided by bringing the motorist to a low speed entry and exit, and by separating the cyclist with a jughandle pathway, and crossing the cyclist at a point in the ramp where the motorist is attending to steering control as opposed to a merge-search sequence. For crossings of freeways and other high speed, high volume arterials, the best solution may be a grade separation with access ramps to adjoining roadways and destinations. This consideration may dictate the exploration of alternative routes since an off-grade crossing can prove cost prohibitive.

For high capacity roundabouts of 2 lanes or more, or rural roundabout locations where higher entry and exit speeds are permitted, bike paths and crossings set back 20 ft. (6 m) from the intersection should be considered.



HIGH SPEED HIGH VOLUME ON TO OFF ROAD TREATMENT

Jughandle Pathway at Freeway Intersection

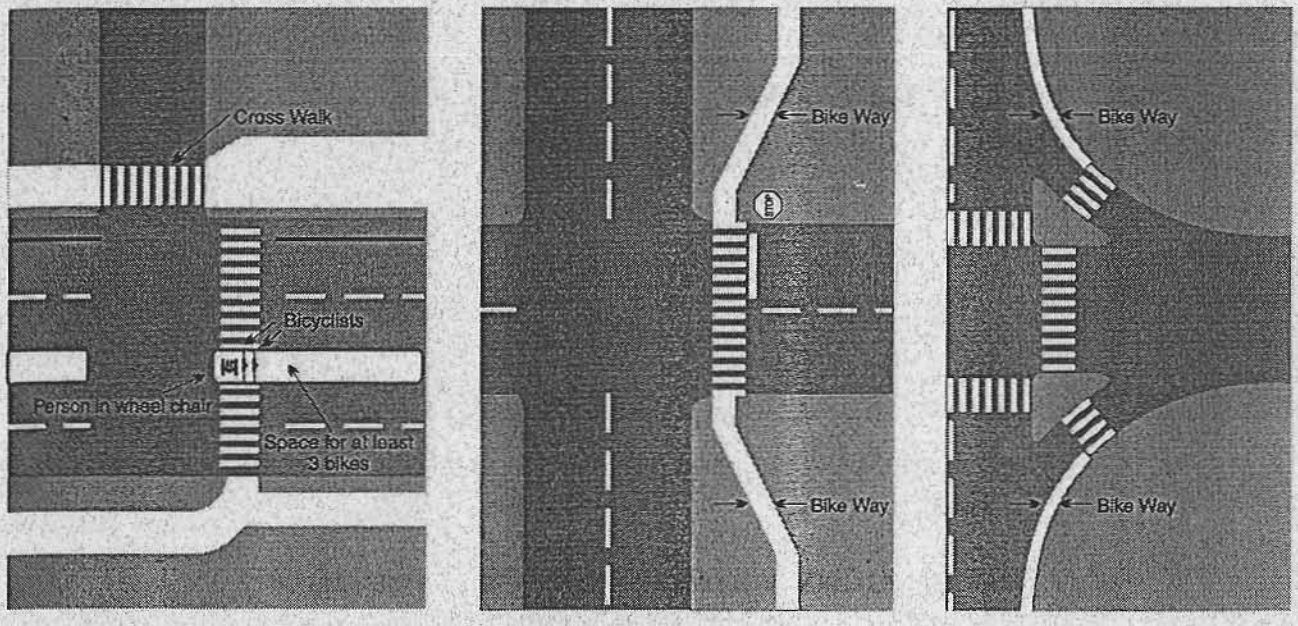
Figure 17-29

When intersections occur at grade, a major consideration is the establishment of right-of-way. At crossings with infrequent automobile traffic such as residential or commercial driveways, bicycles should be given priority. Adequate sight distance and proper signing indicating the right-of-way should be provided. Bike path traffic control signs should be located or shielded so that motorists are not confused by them and roadway signs should also be placed so that cyclists are not confused by them.

Median refuges in path crosswalks should be considered, particularly for multi-lane highways. A bicycle refuge allows cyclists to cross some lanes of traffic without waiting until all lanes are clear. This separates conflicts and simplifies the crossing procedure. The refuge can simply be a cut in the existing median or a structure built specifically as a bicycle refuge.

Minimum median width should be 3 m. This allows .5 m clearance at either end of a bicycle, and can accommodate a tandem pulling a trailer. If large numbers of cyclists can be anticipated to use the intersection simultaneously, a storage space of 3.5 - 4.0 m is preferred.

The median opening should be angled 45 degrees toward the approach traffic. This forces cyclists to stop for a second search and orients them to look directly toward the source of danger. Lighting should be used for median crossings. W11-1 advanced warning signs should be used for the motorist approach, and approach speeds should be regulated and further constricted by design when practicable.



MEDIAN REFUGE

OFFSET BIKEWAYS
INTERSECTION TREATMENT

LOW SPEED-LOW VOLUME
TREATMENT

Intersection of Major Path With Collector Street or Commercial Driveway
Figure 17-30

It is preferable that the crossing of a bicycle path and a highway be at a location away from the influence of intersections with other highways. Controlling vehicle movements at such intersections is more easily and safely accomplished through the application of standard traffic control devices and normal Rules of the Road. Where physical constraints prohibit such independent intersections, the crossings may be adjacent to the pedestrian crossing. Right-of-way should be assigned and sight distance should be provided so as to minimize the potential for conflict resulting from unconventional turning movements.

At crossings of high volume multi-lane arterial highways, especially where signals are not warranted or where elderly, student or younger cyclists are expected, a median refuge area which is large enough to accommodate two or more cyclists is advantageous.

When crossing at mid-block locations, the-right-of way should be assigned by signs, markings, and/or signals. If mid-block at-grade intersections are located at other than low-volume residential streets, they should be diverted to an intersection if possible. If this is not feasible, crosswalk signalization or appropriate warning and stop signs for motorists and cyclists at the mid-block intersection are necessary.

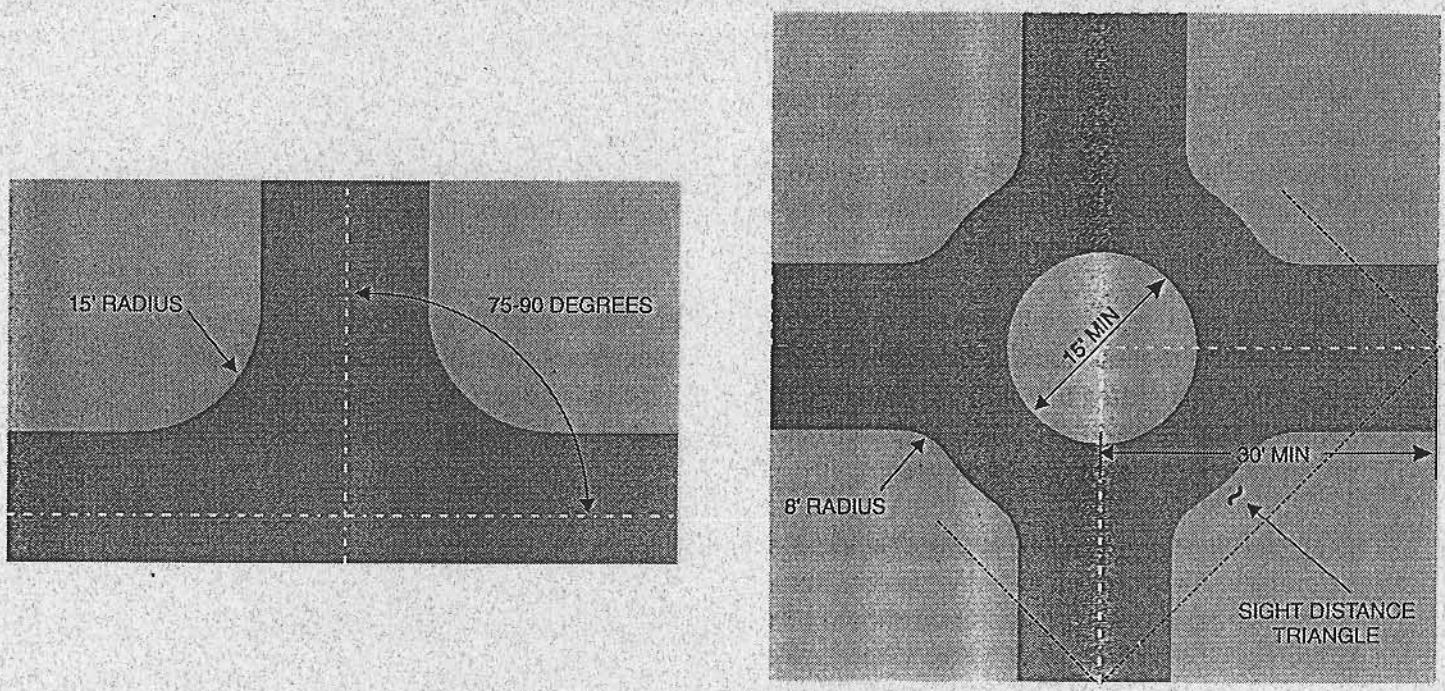
Diverting cyclists from a mid-block crossing to an intersection is difficult because many users will attempt the mid-block crossing even if it is more dangerous, simply because it is more convenient. Diverting the path far enough back from the road in order to visually break the connection will ease the transition to the road intersection. Landscaping, fencing, or other visual or physical barriers may also be used.

Bike path intersections and approaches should be on flat grades to allow for starting and stopping and adequate sight triangle requirements. The maximum grade of the approaches should be 5 percent. Consideration should be given to a flat approach plateau preceded by a short, steep section in areas where slopes are unavoidable.

Curb-cuts at intersections should have the same usable width as the path. They should have 5-foot (1.5 m) wings and a 0" lip in the pan, providing a smooth transition between the path and the roadway.

7.5.2.12 Bike Path/Bike Path Intersections

Intersecting bike paths should be made as perpendicular as possible, and no less than 70 degrees, or should be in a "T" configuration. Consideration should be given to the priority of one path over another. It may be necessary to have one movement yield to another. Intersections between high volume paths should be a rotary rather than a "T."



Typical Path\Path Intersection Treatments

Figure 17-31

17.5.2.13 Signing and Marking

Adequate signing and marking are essential on bike paths, especially at railroad grade crossings and highway intersections. In addition, guide signing, such as to indicate directions, destination, distances, route numbers and names of crossing streets, should be used in the same manner as they are used on highways. Names of crossing streets on highway bridges over bike paths is also an important reference.

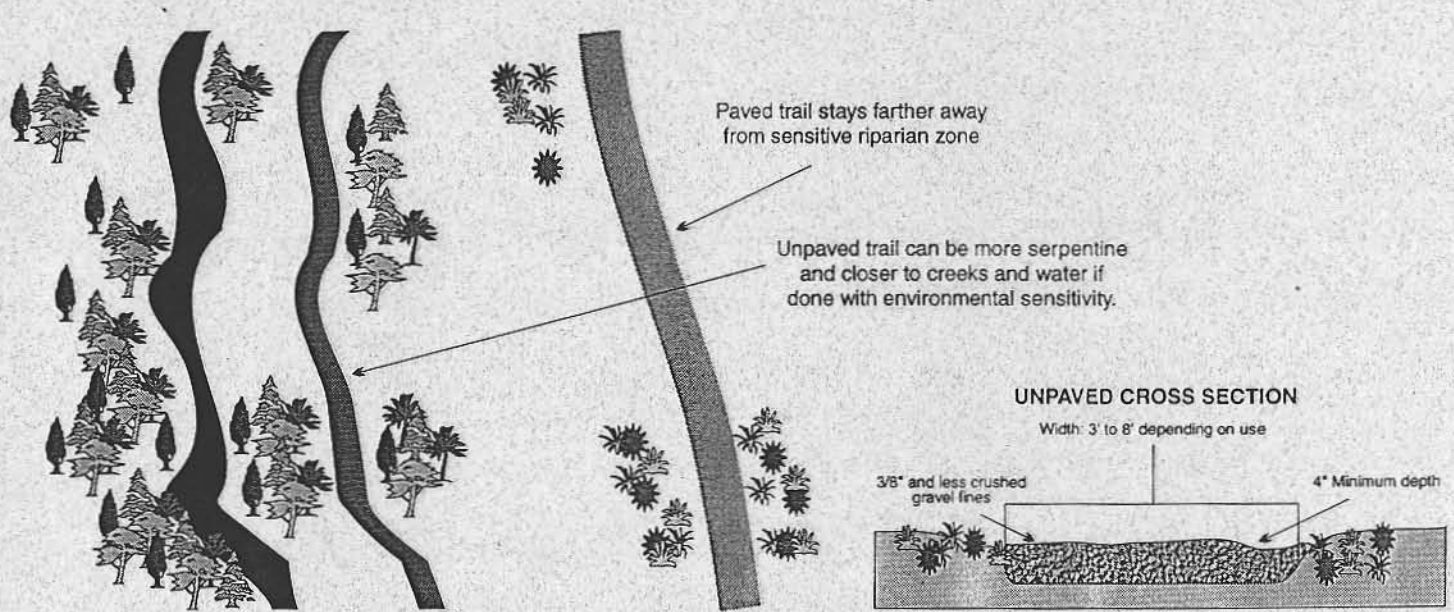
To separate opposite directions of travel on the path, centerline striping should be used, particularly in areas with heavy volumes of bicycles, on curves with restricted sight distance, and on unlighted paths where nighttime riding is expected. Edge lines can also be beneficial where nighttime bicycle traffic is expected.

Ground graphics, whether painted or etched into the concrete, are useful as supplements to posted signs, particularly on multi-use facilities. Many cyclists and pedestrians look down while walking or cycling and are more likely to see information located on the ground. Ground graphics should not be used without posted signage, particularly if it is regulatory, because of the possibility that it may get covered up by snow, sand or other debris, or wear off. Particularly useful are directional arrows, and bicycle and pedestrian symbols which indicate which facilities are to be used by each mode when the facilities are separated.

General guidance for signing and marking of bike paths is provided in the MUTCD. Care should be exercised in the choice of pavement marking materials. Some marking materials are slippery when wet and should be avoided in favor or more skid resistant materials. Reflective materials should also be considered.

17.5.2.14 Unpaved Paths

Unpaved transportation paths or trails should be constructed with surface materials which provide stability and remain relatively firm when wet. The color of the surface should blend with the natural environment to minimize visual impact. Provide structures necessary to prevent erosion of surface material, such as concrete pans at cross drainage locations and water bars or short paved sections on slopes to limit erosion. There should be at least 8 feet of vertical clearance from vegetation. The maximum grade should be 6%.



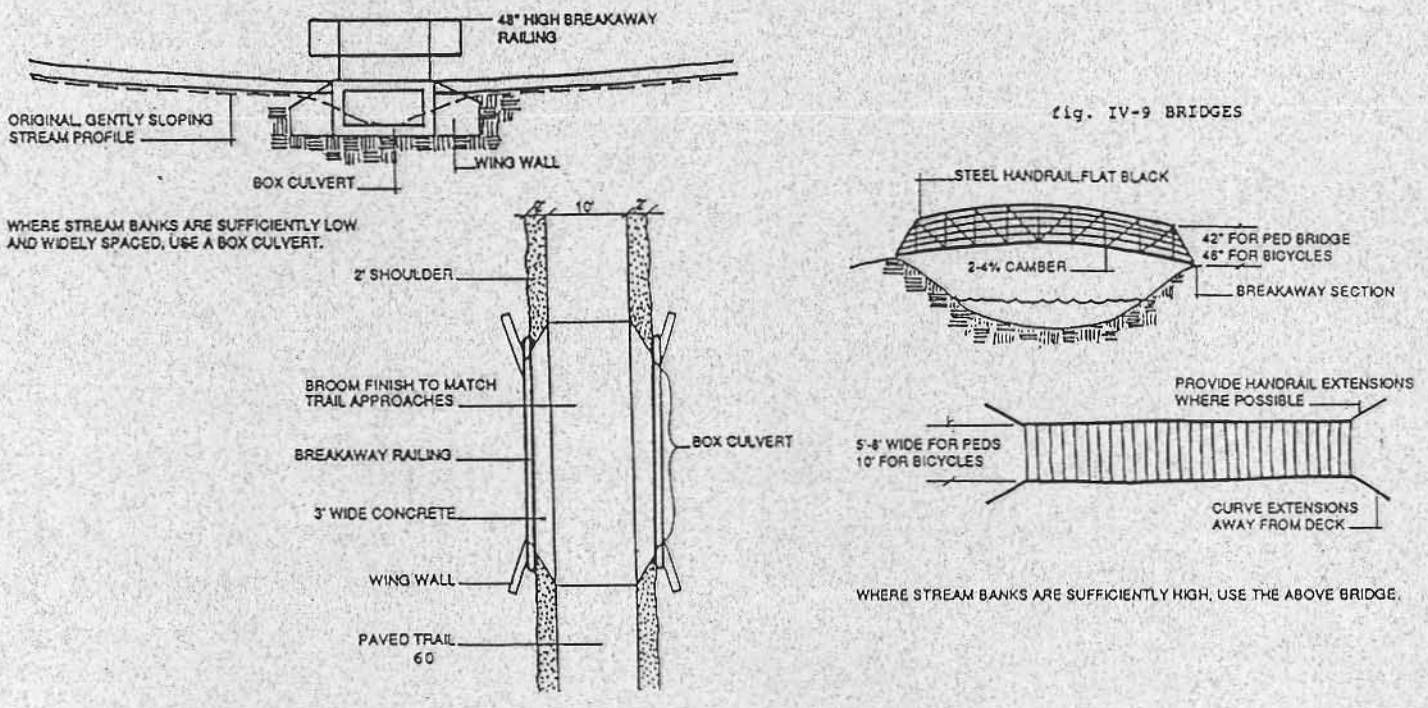
Gravel Trail in a Typical "Greenway" Setting With Adjacent Paved Trail
Figure 17-32

Where there is no parallel paved trail, the unpaved trail should have a minimum width of 8 feet (2.4 m), and edges appropriate to protect adjacent vegetation. In urban settings or where high volumes are expected, a minimum 10 foot (3 m) width should be used. Where there is a parallel paved bicycle path, the minimum width of the unpaved pedestrian path is 3 feet (1 m).

17.5.2.15 Underpasses, Overpasses, Bicycle/Pedestrian Bridges

On all new structures (underpasses, bridges, or overpasses) the minimum width should be the same as the paved approach bicycle path plus the clear zone (minimum 2 foot [0.6 m] wide each side). Carrying the clear zone across the structures provides two advantages. First, it provides a minimum horizontal shy distance from the railing or barrier, and secondly, it provides needed maneuvering space to avoid conflicts with pedestrians, other bicyclists, and maintenance vehicles which may be stopped in or on the structure. The 10 foot (3 m) minimum width for these structures should only be used for short distances with good sight distances and level approaches, and in low-volume rural areas.

Bridges should be placed, and bridge approaches designed, so that there are no sharp curves or deflections. Users should not have to initiate turning movements directly adjacent to or while on a bridge. Typically, if maintenance vehicles cannot negotiate the bridge layout, the layout is unacceptable for cycling.



Miscellaneous Bridge and Stream Crossing Treatments

Figure 17-33

Multi-Use Trails

Recommended Design Standards

Trail Design and Construction

New and reconstructed trails should be designed to be safe and non-circuitous, especially trails used for commuter bicycling. The aesthetic and natural aspects of the trail experience should be given important consideration in the design of all projects. Attention should always be given to the protection of existing vegetation. Aesthetic amenities and appropriate vegetation should be included in all trail planning and design.

Trail Configurations and Features:

- Design multi-use trails to encourage safe riding and walking by maintaining good sight distance. Design to prompt riders to be aware of other users at intersecting points. Avoid designs that encourage careless merging movements
- Avoid trail designs that include any unsignalized mid-block crossings of roadways, particularly arterial roads.
- Include curb cuts at all new trail and roadway intersections.
- Provide highly visible pavement markings to warn users of upcoming intersections, traffic crossings, and stop signs.
- Mark center lane stripes on all two-way trails in high congestion areas and restricted visibility zones.
- Provide and maintain vandal-proof lighting under all new bridges and underpasses over 20 feet wide that cross trails. Retrofit existing underpasses and bridges with adequate lighting.
- Avoid placing bollards and other small fixed hazards in the path of riders and walkers. Bollards should not be installed unless trail operational histories indicate they are truly needed.
- Maintain a three-foot minimum, clear recovery zone adjacent to all trails for bicycle use, when possible.
- Avoid trail alignments that go up and down hills needlessly.
- Include protective railings meeting AASHTO recommendations on new trails, ramps, and landings adjacent to abrupt grade changes. The ongoing program to retrofit existing trails, ramps, and landings with protective railings should be continued with adequate funding.

Trail Width:

- Add a smooth, consistent soft-surface path parallel to the existing hard-surface trail where possible to more safely and comfortably accommodate slower speed foot traffic when upgrading an overused or overcrowded pathway, instead of widening the existing paved trail. Where practical, consider the use of a planted strip to separate these trails to reduce surface materials being carried between trails.
- Establish normal width for new two-way paved trails of 10 feet; soft-surface trails should be five to six feet wide. If available right-of-way does not permit a parallel soft path, a 12-foot width may be considered.

Trail Elevation and Slope:

- Construct all new trails to be at least above the two-year flood plain, except where not possible due to clearance deficiencies.
- Design trails so that the maximum longitudinal slope does not exceed A.D.A. Standards slope of 1: 12.

Trail Materials:

- When asphalt trails need to be completely reconstructed due to deterioration, replace them with a concrete surface, if funds are available.
- If complete funding is not available, choose between systematic conversion of existing asphalt trails to concrete, or application of interim asphalt overlay, depending on which is most cost-effective.

Trail Drainage and Maintenance Considerations:

- Construct trail surface with a one-inch vertical offset (1" above adjacent ground).
- Design trails to have adequate cross-drainage.
- Ensure all adjacent public works projects include provisions to minimize sheet flow cross-drainage, and to prevent concentrated drainage or run-off from areas adjacent to the trail.
- Design bridge deck drains to prevent drainage from running onto trail surfaces.
- Maintain a three-foot clear zone with swales along the uphill side of all trails to help reduce debris deposited on the trail by run-off flows.
- Design trails to facilitate easy snow removal, sweeping, and other maintenance.
- To accommodate maintenance vehicles, design heavily-used trails so that the minimum turning radius, measured at the inside curve, is 20 feet (15 feet on lower use trails).
- Design all bridges over trails so that snow being plowed does not fall over the edge on to trails.
- Ensure regular plowing of all trails used by bicyclists in winter.
- Provide adequate and regular control of thorns on trails through environmentally safe methods.
- Design structures adjacent to trails (bridges, walls, etc.) to be vandal-proof and graffiti-resistant.
- Prior to new facility implementation, ensure that the appropriate agency or agencies agree upon responsibility for ongoing maintenance and snow removal. This should include scheduled maintenance, and maintenance in response to calls from citizens.
- Refer to "Recommended Trail Maintenance Considerations" for a more-detailed maintenance discussion.

Trail-Heads

- Design trail-heads sensibly, and provide access to maintenance vehicles.
- Provide parking at new trail-heads. Consider the addition of parking at existing trail-heads where possible.
- Locate trail-heads where they will not cause negative impacts on surrounding neighborhoods.

Automatic Water Sprinkling Systems

Sprinkling Schedule:

- Develop schedule for sprinkler operation to ensure that cross-trail irrigation does not occur during peak commute hours.
- Implement a system to monitor and report complaints of cross-trail irrigation, and respond to those complaints expediently.

Sprinkler System Design:

- Design new systems to avoid cross-trail irrigation.
- Evaluate the cost-effectiveness of retrofitting existing cross-trail irrigation systems in high trail-use areas.

Fixtures

Toilets:

- Provide toilets at all trail heads and at all major parks along trails.
- Locate toilets approximately every three miles along trails.
- Design toilets so that are easily maintained.

Drinking Water:

- Utilize wall or post spigots (or handpumps) for durability and simplicity.
- Provide drinking water approximately every one-and-a-half miles, and at all major parks along trails.
- Cluster toilet and drinking facilities where possible.

Benches:

- Provide benches approximately every two miles along trails, or where people may want to stop. More benches may be necessary along trails with higher use. Consider local user needs to determine number of benches needed.

Signage

- Provide comprehensive signage as an integral component of all new bicycle projects.
- Retrofit existing facilities with signage as necessary.
- Install signage to address the following issues:

Safety Signage

- Advisory to "share the road"
- Speed regulations that are realistic with enforcement capabilities
- Advisory to "Travel on the right side, pass on the left"
- Recommendation to announce intention to pass with bell, horn or voice
- Advice of restricted access areas
- Recommendation of bicycle helmet use
- Regulatory signage prohibiting motor vehicles

Informational Signage

- General informational signage, such as mile markers, points of historical or natural interest
- Signs at major entrances to trails, including trail maps
- Directional indicators at connections to activity centers and areas of interest
- Route information
- Directional signage, including local street names

Bridges

Existing Bridges:

- Access-restriction bollards are not necessary on bridges less than eight feet wide.

New Bridges:

- Minimum bridge width, from inside railing to inside railing, should be 10 feet. Additional width is especially appropriate on principal routes.
- All low-water bridges must be of a clear-span open-waterway design, and should never utilize a small-diameter culvert design. Preferred elevation is above the two-year flood level.

Law Enforcement

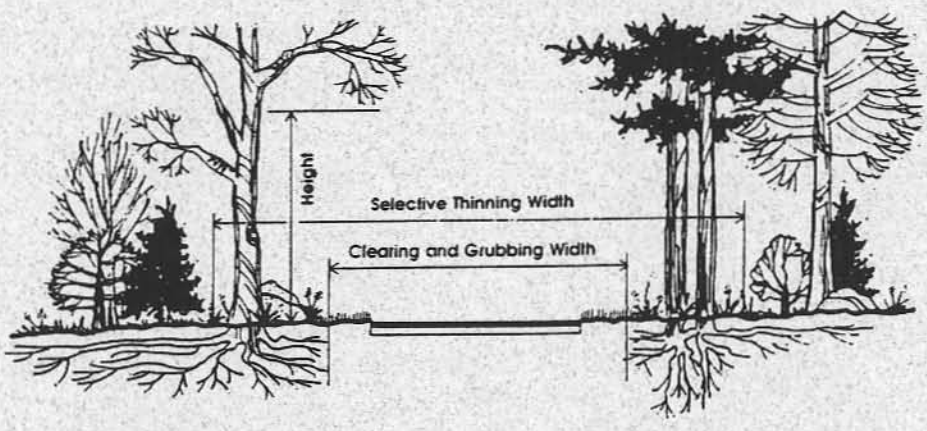
- Focus law enforcement efforts on increasing safety for all trail users. Stress safe bicycle riding, especially as it relates to other modes.
- Curtail threats to personal safety related to gang and indigent activities.
- Encourage established Police Department bicycle patrols to routinely ride the trails.
- Consider Bicycle Volunteers to monitor City trails.

Intra-Agency and Inter-Agency Coordination

- Review all trail improvement projects and adjacent public works projects during design development by Parks and Recreation Planning Division, Parks maintenance managers, and the City Bicycle and Pedestrian Planner.
- Review construction and improvement project work orders in the vicinity of recreational trails by Parks maintenance and Parks and Recreation Planning Division prior to execution.
- Share overall responsibility and authority for planning and inter-agency coordination of bicycle projects and activities between the City Bicycle and Pedestrian Planner, Parks and Recreation Planning Division, and Trails Coordinator.
- Ensure adequate trail detours during trail construction or impacts from adjoining projects.

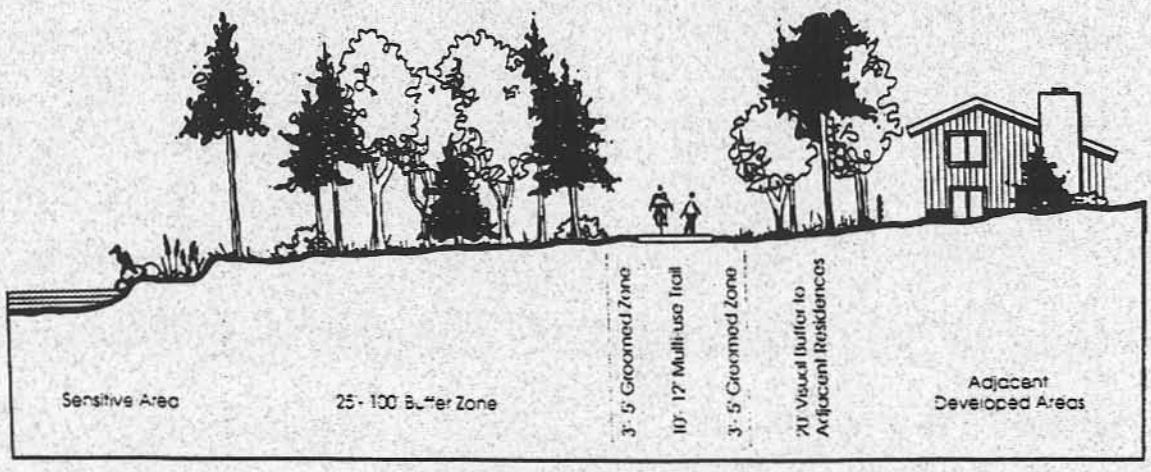
- *Guidelines for Creating Greenways* contains a similar set of standards for Multiuse and greenway trail treads. In addition, this book contains horizontal and vertical clearances as applicable to major trail users. See Figure 44.

Figure 44. Vegetative Clearing



Trail Type	Clearing & Grubbing Width	Selective Thinning Width	Clearing Height
6-foot hiking only	10 feet	20 feet	8 feet
8-foot pedestrian only	14 feet	24 feet	8 feet
10-foot pedestrian only	16 feet	26 feet	8 feet
8-foot bicycle only	16 feet	26 feet	10 feet
10-foot bicycle/pedestrian	18 feet	28 feet	10 feet
6-foot horse only	12 feet	22 feet	12 feet
10-foot horse/pedestrian	16 feet	26 feet	12 feet
8-foot cross-country ski only	12 feet	22 feet	8 feet
12 foot snowmobile only	20 feet	30 feet	10 feet
18-foot ski/snowmobile	26 feet	36 feet	10 feet

Figure 45. Typical Cross-Section of Trail Near Sensitive Areas



Source: GUIDELINES FOR CREATING GREENWAYS
THE GREEWAY COLLABORATIVE

Recommended On-Street Bicycle Route Maintenance Standards

Proper maintenance of on-street riding surfaces is a key factor in bicycle safety and an important consideration in people's decision to ride a bicycle. Designing bikeways to reduce maintenance, giving priority to the sweeping and plowing of the sides of streets where bicyclists ride, and ensuring that riding surfaces are relatively smooth- are all requisites in attracting more of the general public to bicycling. To improve the condition of bicycle routes, it is recommended that the City adopt the following standards for facilities within the public rights-of-way used by bicyclists:

- Maintenence responsibility
  Responsiblity for on-going maintenance for each bicycle facility must be assigned and assumed prior to its construction or official designation. Responsibility for on-street maintenance rests primarily with the Public Works Department or the DOT. Responsibility for the removal of debris or snow deposited onto a bicycle path or route by any public agency or private concern will be assumed by that agency or concern.

- Location of on-street maintenance activities
  Maintenence will be provided regularly on areas where bicycles are legally operated on: streets, officially-designated "bicycle sidepaths" and along viaducts. Special emphasis will be placed on the maintenance of designated routes.

- Street sweeping
  Whenever any street is swept, ensure that the area cleaned also includes the sides of roads where bicycles are ridden. Sweep all the way to gutters on "no parking" streets and adjacent to cars on streets where parking is permitted. Ensure that surface debris, dirt, broken glass and sand is removed quickly from bicycle travel areas. Special attention should be given to a thorough cleaning in April to remove sand deposited during the winter.

- Snow plowing
  Designated bicycle route streets should be given priority as "snow routes". Plowing standards should ensure snow is removed from bicycle travel zones. This includes plowing all the way to gutters on "no parking" streets and adjacent to cars on streets where parking is permitted. Snow is not to be stored on plowed into bicycle travel zones.

- Surface repair
  A constant repair program should be in place to maintain a uniform, smooth surface on bicycle route streets for bicycle riding. Ensure that any repair of a street surface, including pothole filling, includes repair of the pavement in bicycle travel zones.

- Scheduling
  Inspections, maintenance and repair will be regularly scheduled. Inspection of all on-street facilities, including signage and street surface markings, will be done at least annually. Scheduling of repairs for any deficiencies will be included in this inspection.

· Bicycle route priority
Work with City agencies to give roughly equal priority for bicycle and motor vehicle facility maintenance.

· Maintenence-on-call

develop
a system to receive, verify, organize and respond to citizen reports about unsafe road surface conditions on bicycle routes. If this system is well-managed it can become an inexpensive way to improve reporting of problems and be a way to mitigate "constructive notice" issues.

· Future Maintenence
Over the next few years expand maintenence capabilities to obtain a higher general level of street conditions, especially on street surfaces used by bicycles. This should include additional staff for more frequent street sweeping and plowing, special equipment to maintain non-standard areas used for bikeways (such as sidepaths on viaducts), and special training and supervision for improved bicycle route maintenence.

Recommended Trail Maintenance Considerations

Maintenance to be performed on a continuous, scheduled basis:

1. Trail-user safety

Safety is central to all maintenance operations, and is the single most important trail maintenance concern. Items for consideration include scheduling and documentation of inspections, the condition of railings, bridges, and trail surfaces, proper and adequate signage, removal of debris, and coordination with other agencies associated with trail maintenance

2. Trails inspection

Trails inspections are integral to all trail maintenance operations. Inspections will occur on a regularly scheduled basis, the frequency of which will depend on the amount of trail use, location, age, and the type of construction. All trail inspections are to be documented.

3. Trail sweeping

Trail sweeping is one of the most important aspects of trail maintenance, and helps ensure the safety of trail users. The type of sweeping to be performed depends on trail design and location. Trails that require sweeping of the whole system will be swept by machine. Trails that require only spot sweeping of bad areas will be swept by hand or with blowers. Some trails require a combination of methods. Trail sweeping will be performed on a regularly scheduled basis.

4. Trash removal

Trash removal from trail corridors is important from both a safety and an aesthetic viewpoint. Trash removal includes removing ground debris and emptying trash containers along the trails. Trash removal will take place on a regularly scheduled basis, the frequency of which will depend on trail use and location.

5. Tree and shrub pruning

Tree and shrub pruning will be performed for the safety of trail users. Pruning will be performed to established specifications on a scheduled and as needed basis, the frequency of which will be fairly low.

6. Mowing of vegetation

The trails maintenance personnel will mow the vegetation along trail corridors on a scheduled basis only where mowing is not performed by other agencies or park districts.

7. Scheduling Maintenance Tasks

Inspections, maintenance, and repair of trail related concerns will be regularly scheduled. Inspection and repair priorities should be established, dictated by trail use, location, and design. Scheduling maintenance tasks is a key item towards the goal of a consistently clean and safe trail system.

Maintenance to be performed on an irregular or as needed basis:

1. Trail Repair

Repair of asphalt or concrete trails will be closely tied to the inspection schedule. Prioritization of repairs is part of the process. The time between observation and repair of a trail will depend on whether the needed repair is deemed a hazard, to what degree the needed repair will affect the safety of the trail user, and whether the needed repair can be performed by the trails maintenance crew or if it so extensive that it needs to be repaired by outside entities.

2. Trail Replacement

The decision to replace a trail and the type of replacement depends on many factors. These factors include the

age of the trail, and the money available for replacement. Replacement involves either completely overlaying an asphalt trail with a new asphalt surface, or replacement of an asphalt trail with a concrete trail. In general, replacing asphalt trails with concrete is desirable. (A discussion of the different philosophies concerning the replacement of an asphalt trail with a concrete surface can be found elsewhere in the Bicycle Master Plan.) Parks Planning will coordinate all trail replacement, and the Trail Coordinator will recommend trails for replacement.

3. Snow and ice removal

The trails maintenance crew, with the help of the various districts, will remove snow from all city trails as soon as possible after a snowfall. The trails crew will provide help as needed to any district. Ice control and removal of ice build-up on trails is a continual factor because of the freeze-thaw cycle, . Ice control is most important on grade changes and curves. Ice can be removed or gravel/ice melt applied. After the ice is gone, leftover gravel should be swept as soon as possible.

4. Weed control

Weed control along trails will be limited to areas in which certain weeds are creating a hazard to users. An example is the "goathead" thorns deposited on trails in some areas. Environmentally safe weed removal methods should be used, especially along waterways.

5. Trail Edging

Trail edging maintains trail width, and increases trail drainage. In the past, sweeping operations and failure to sweep to the edge have created berms on both sides of some trail sections. In addition, uphill slopes adjacent to the trails have eroded onto some trail sections. Removal of this material will facilitate proper draining of the trail surface, allow the flowing action of the water to clean the trail, and limit standing water on trail surfaces. Proper drainage of trail surfaces will also limit ice build-up during winter months.

6. Trail drainage control

In places where low spots on the trail catch water, trail surfaces should be raised or drains built to carry away water. Some trail drainage control can be achieved through the above-mentioned edging of trails. Wherever trail drainage is corrected near steep slopes, the possibility of erosion must be considered.

7. Trail signage

Trail signage falls into two categories: safety and information. Overall, trail users should be informed via signage of where they are, where they are going, and how to use trails safely. Signs related to safety are most important and should be considered first. Information signage can enhance the trail users experience. A citywide system of trail information signage should be a goal.

8. Revegetation

Areas adjacent to trails that have been disturbed for any reason should be revegetated to minimize erosion.

9. Habitat enhancement and control

Habitat enhancement is achieved by planting vegetation along trails, mainly trees and shrubs. Enhancement can improve the aesthetics of the trail, help prevent erosion, and provide for wildlife habitat. Habitat control involves mitigation of damage caused by wildlife. An example is the protection of trees along waterways from damage caused by beavers.

10. Public awareness

Creating an understanding among trail users of the purpose of trails and their proper use is a goal of public awareness. Basic concepts of trail use include resolution of user conflicts, and speed limitations. The philosophy of trail use is not a direct concern of the maintenance program, but is certainly of interest. Also, trail representatives should be easily accessible to field questions and concerns.

11. Trail program budget development

A detailed budget should be created for the trails program, and revised on an annual basis.

12. Volunteer coordination

The use of volunteers can help to increase public awareness of trails, and provide a good source of labor for the program. Possible sources of volunteers include Boy Scout troops, school groups, church groups, trail users, or court workers. Acknowledgement of volunteers' concerns are important, as are possible incentives or recognition of work performed. Implementation of an "Adopt-a-Trail" program should be considered.

13. Records

Good record-keeping techniques are essential to an organized program. Accurate logs should be kept on items such as daily activities, hazards found and action taken, maintenance needed and performed, etc. Records can also include surveys of the types and frequency of use of certain trail sections. This information can be used to prioritize the needs of trail management.

14. Graffiti control

The key to graffiti control is prompt observation and removal. During scheduled trail inspections, occurrences of graffiti should be noted, and the graffiti removal crew promptly notified.

15. Mapping

Many detailed maps are privately marketed and available for the trail user. From a maintenance standpoint, a more detailed map of the Denver trail system than is presently available is needed for internal park use.

16. Coordination with other agencies

Maintenance of trails located within more than one jurisdiction, like the Platte River Trail and the High Line Canal Trail, is provided by the government agencies in addition to the Denver Parks and Recreation Department. A clear understanding of the delegation of maintenance responsibilities needs to be established to avoid duplicating efforts or missing maintenance on sections of the trails.

17. Education and interpretation

Many segments of the trail system contain a wealth of opportunities for education and interpretation. A successful example operated through the Denver Public Schools is the Greenway Experience, which has been in place for many years. The greatest opportunities exist on trails located along waterways where concepts about urban wildlife and ecology can be easily viewed and learned. Educational opportunities range from interpretive signage to educational tours.

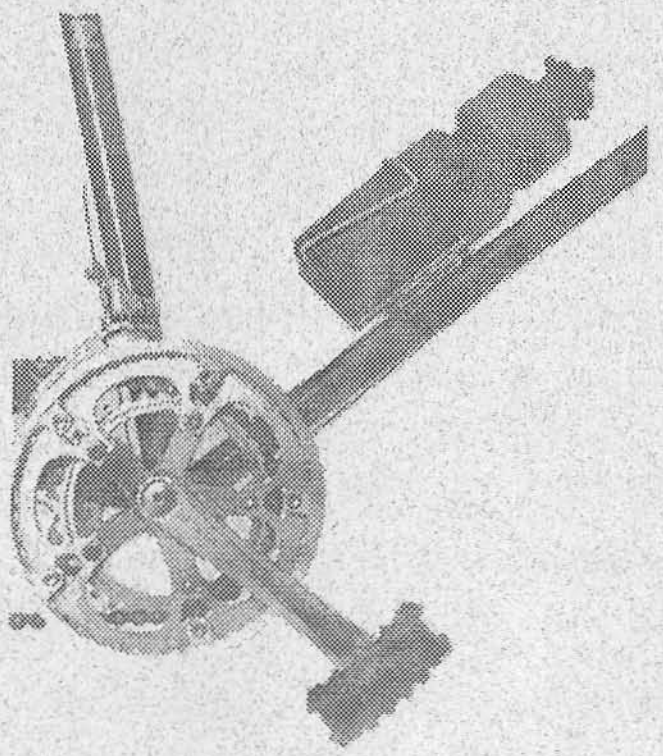
18. Law enforcement

A greater law-enforcement effort might be made toward the goal of a safer trail system. Law enforcement agencies should be aware about the location of trails, and the types and levels of use they receive. Sections of trail corridors being used by transients is an ongoing problem that is not easily solved. Increased law enforcement awareness will be addressed on an as needed basis.

19. Proper training of employees

Properly training maintenance employees is essential to the efficient operation of the trails maintenance program. All employees should be thoroughly trained to understand and be aware of all of the above-mentioned aspects of trail maintenance. Safety, a good work ethic, and proper care of equipment and tools will always be the backbone of a good training program. Employees must also be aware of the need for positive public contact. Proper positive attitude towards public questions and concerns is important, as is the conveyance of this information to trail supervisors.

VII. APPENDIX



BIBLIOGRAPHY

The Bicycle Advocate's Action Kit, The Bicycle Federation of America, 1993.

The Bicycle Forum, The Bicycle Federation of America, January, 1994.

Bicycle Path Intersection Signing Study for the City of Billings, Montana, prepared by HKM Associates, Billings, Montana, June 1992.

Bicycle/Pedestrian Plan Development Guidebook for Colorado Transportation Planning Regions, Colorado Department of Transportation, Denver, Colorado, July, 1993.

Billings South Side Storm Sewer Master Plan for the City of Billings, Montana, prepared by Morrison-Maierle, Inc., January, 1981.

Bicycle and Pedestrian Planning Under ISTEA- Federal Highway Administration, May, 1994.

Bikeway Plan for Billings, Montana, prepared by Billings-Yellowstone City-County Planning Board, October, 1980.

Billings Transportation Plan, Billings, Montana, 1990.

Billings Transportation Improvement Program (TIP) for FY 1994-1998, amended, Yellowstone County Board of Planning, Billings, Montana.

Boulder's Greenway Design Guidelines, Boulder Colorado, 1994.

Canals and railroads, issues of Access and Liability for Trails, Colorado state parks, Denver, Colorado, 1994

Cascade Bicycle Club, Government Affairs Committee, Bicycle Transportation Policy and Advocacy handbook, Seattle Washington, May 1991, 1993 revised

City of Billings and Kiwanis Club of Billings ISTEA proposal for bikeway development, April 1993.

Comprehensive Bikeway Plan for Billings, Montana, Wirth Associates, Billings, Montana, 1975

CTEP, Project Proposal Guidelines, Instructions and Proposal Form, September 1993, Metra Park.

CTEP, Project Proposal Guidelines, Instructions and Proposal Form, September 1993, Yellowstone Greenway Project.

Denver Bicycle Master Plan, City and County of Denver Colorado, 1993.

Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors. A Resource Book, Prepared By: Rivers and Trails Conservation Assistance National Park Service, 1990.

The National Bicycling and Walking Study-Transportation Choices for a Changing America, Federal Highway Administration Series:

Case Study #3,	What Needs to be Done to Promote Bicycling and Walking?
Case Study #5,	An Analysis of Current Funding Mechanisms for Bicycle and Pedestrian Programs at the Federal, State and Local Levels.
Case Study #6,	Analysis of Successful Grassroots Movements Relating to Pedestrians and Bicycles and a Guide on How to Initiate A Successful Program.
Case Study #8,	Organizing Citizen Support and Acquiring Funding for Bicycle and Pedestrian Trails.
Case Study #11,	Balancing, Engineering, Education, Law Enforcement and Encouragement.
Case Study #12,	Incinerating Consideration of Bicycles and Pedestrians into Education Programs.
Case Study #13,	A Synthesis of Existing Bicyclist and Pedestrian Related Laws and Enforcement Programs.
Case Study #18,	Analyses of Successful Provincial, State and Local Bicycle and Pedestrian Programs in Canada and the United States.
Case Study #19,	Traffic Calming, Auto-Restricted Zones and Other Traffic Management Techniques-Their Effects on Bicycling and Pedestrians.
Case Study #21,	Integrating Bicycle and Pedestrian Considerations Into State and Local Transportation Planning, Design and Operations.
Case Study #22,	The Role of State Bicycle/Pedestrian Coordinators.
Case Study #23,	The Role of Local Bicycle/Pedestrian Coordinators.
Case Study #24,	Current Planning Guidelines and Design Standards Being Used By State and Local Agencies for Bicycle and Pedestrian Facilities.

Guide for the Development of Bicycle Facilities-AASHTO, August 1991.

Innovations in Public Involvement for Transportation Planning, Department of Transportation, Federal Highway Administration, January, 1994.

License Agreement to Construct Concrete Trail along the Wellman Canal in the Vicinity of Colorado Avenue, Denver, Colorado, (sample ditch easement).

Missoula Non-Motorized Transportation Plan-Guidelines for Creating a Non-Motorized Travel Network in the Greater Missoula Area, October, 1993.

Montana Statewide Comprehensive Outdoor Recreation Plan, Outdoors in Montana, 1983 and 1988.

Ordinance No. 5199: Title 9 Land Use Regulation, City of Boulder

Oregon Bicycle Plan, July, 1992.

North Park Neighborhood Plan, Yellowstone County Board of Planning, July 1993.

State of Colorado, Draft Bicycle Guidelines, March, 1994.

School Sidewalk Improvements for Billings, Montana, HNB Consulting Engineers, Cheyenne, Wyoming, July 1992.

Shiloh Road Corridor Study, prepared by Yellowstone County Planning Department, Billings, Montana, February 1993.

Transportation Enhancement Program Nominations, Billings and Yellowstone County for FY 1994.

Transportation Enhancement Program Projects, Billings and Yellowstone County, Funded FY 1992-1993.

Transportation for Livable Communities, Prepared for the Business Transportation Council, By Laura Briggs and Richard Bradley.

Yellowstone County Comprehensive Plan, Yellowstone County, Montana, 1990.

MAPS and BROCHURES

Basics of Bicycling, Bicycling Federation of America.

Bicycling Denver Metro Route Map, Denver Bicycle Touring Club, Inc., Denver, Colorado, 1992.

Billings Neighborhood boundaries: Central/Terry Park; North Park; Southwest Corridor; South Park; North Elevation; and the Heights Neighborhoods.

Billings Points of Interest Map, Billings Chamber of Commerce.

Billings, Montana, Surface Management Status Map, Bureau of Land Management, 1989.

Boulder's Greenways, Self-Guided Tour Map, Boulder, Colorado.

MET Transit Route for Billings, Montana.

Major Street Network, Functional Classification, Billings, Montana.

School District Boundary Maps for elementary, junior high and high schools in Billings.

PLANS

Bikeway from Pioneer Park to North Park, November, 1976. Corresponds to the 1975 Bikeway Plan.

Billings Bikeway Project, July 1983. Corresponds to the 1980 Bikeway Plan.

West End Storm Drainage Plan, City of Billings

City of Billing, Map. GIS

USGS Topographic Quad Maps

GLOSSARY

TIP	Transportation Improvement Program
STIP	State Transportation Improvement Plan
STP	Surface Transportation Program
MDT	Montana Department of Transportation
FHWA	Federal Highway Administration
AASHTO	American Association of State Highway and Transportation Officials
DOT	Department of Transportation
ISTEA	1991 Intermodal Surface Transportation Efficiency Act
CTEP	Community Transportation Enhancement Program Administered by MDT
YRPA	Yellowstone River Parks Association
MUTCO	Manual of Uniform Traffic Control Devices
TRAC	Transportation, Recreation, Access, Conservation

DEFINITIONS

Bicycle: A vehicle having two tandem wheels, either of which is more than 16" in diameter or having three wheels in contact with the ground any of which is more than 16"propelled solely by human power, upon which any persons or person may ride.

Bicycle Facilities: A general term denoting bicycle improvements and provisions made by public agencies to accommodate or encourage bicycling including parking facilities, mapping of all bikeways, and shared roadways not specifically designated for bicycle use.

Bicycle Lane: A portion of a roadway which has been designated by striping, signing and pavement markings for the preferential or exclusive use of bicycles.
(Standard widths are 4'-6')

Wide Outside Lane
Wider outside vehicle lanes (greater than 12') are created to accommodate parallel travel of vehicles and bicycles on the outside edge of the lane. In the absence of bicyclists, vehicles may use the extra width.

Bicycle 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.

Bicycle Route: A segment of a system of bikeways designated by the jurisdiction having authority with appropriate directional and informational markers with or without specific bicycle route number. (The decision to provide a route should be based on providing continuity of system and advisability encouraging bicycle use on a particular road instead of a parallel and adjacent highways.)

Bikeway: Any road, path, or way which in some manner is specifically designated as being open to bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.

Shared Roadway: Any roadway upon which a bicycle lane is not designated and which may legally be used by bicycles regardless of whether such facility is specifically designated as a bikeway.

Shoulder Bikeway/Walkway:
Shared roadway designed for bicycle and pedestrian usage. Common in rural areas, Shoulder Bikeways/Walkways accommodate cyclists on paved roadway shoulders resulting in fewer conflicts with motor vehicles.

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

Right of Way- A general term denoting land, property or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Roadway: the portion of the highway, including shoulders for vehicle use.

Sidewalk: The portion of a highway designed for preferential or exclusive use by pedestrians.

Traffic Calming: Traffic calming aims to reduce the dominance and speed of motor vehicles. It employs a variety of techniques to cut vehicle speeds. Traffic calming is far from a policy against the car. It simply means motor traffic has to loose its dominance in cases where it has become a nuisance and a danger. Effective applications emancipate the pedestrians , reclaim public and cycle transport and preserve the historic built environment. Three decades of experience have shown that traffic calming can solve many but not all traffic problems. Reductions in speed accidents, noise, pollution, and congestion have been achieved as have more livable neighborhoods, vibrant shopping street and malls and improved conditions for bicyclists and pedestrians. (Definition taken from FHWA Case Study No. 19)

Greenway: A greenway is a linear, landscape corridor of significant length accommodating multiple uses. The City of Billings West End Storm Drainage Master Plan proposes a system of Greenways to manage storm water run off. These same corridors are proposed for bicycle use in this plan.