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# BIKEWAYS Guide

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Minnesota State Planning Agency



## **BIKEWAYS GUIDE:**

## Model Criteria For Bikeways And Recreational Lanes Within The Highway Right-of-Way

Transportation Planning Minnesota State Planning Agency 550 Cedar Street St. Paul, Minnesota 55101

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#### I. INTRODUCTION

#### Purpose

In the Laws of Minnesota for 1973, Chapter 620, the State Planning Agency is instructed to propose model standards for the establishment of bicycle and recreational vehicle lanes on and along proposed and existing public highways.

The primary trail use within the highway right-of-way is bicycling. In addition to bicycle lanes within highway rights-of-way, Minnesota laws of 1973, Chapter 620 refers to recreational vehicle lanes. Recreational vehicle lanes are considered to be snowmobile trails within highway rights-of-way. The Federal Highway Act of 1973 authorizes the use of Federal Aid Highway funds for bicycle and pedestrian lanes on or near federal aid highways and allows for the use of those lanes by snowmobiles when appropriate.

There are other trail users that may wish to use portions of the highway right-of-way. Pedestrians and hikers fall into this category. Ski touring participants may wish to use the highway right-of-way. Equestrians also may wish to use portions of the highway right-of-way for their horseback riding activities.

A discussion of planning considerations, specific recommendations for the designing of bikeways and bikeway facilities, standards for the construction of bikeways, a strategy for signing bikeways, and a discussion of collateral facilities that would improve the usefulness of bikeways are discussed in these bikeway criteria. Also included is a short description of the circumstances under which other trail uses may be included within the highway right-of-way.

#### Approach

These standards are not meant to be rules which must be adhered to strictly in all cases but are meant to be used as a guide in the development of specific bikeway facilities. Engineering judgment must be used to assure that the most appropriate facility is provided.

The criteria included in these standards are not necessarily derived from engineering studies, but are based on the experiences gained through the development of facilities throughout the United States and several other countries. As experience is gained in the development of bikeways in Minnesota and as demand for such facilities in Minnesota increases, it is expected that these criteria will be re-evaluated and specific engineering studies will be done.

The most comprehensive discussion of bikeway design criteria available to date can be found in the publication *Bikeway Planning Criteria and Guidelines*, published in April 1972, by the California Division of Highways. The manual was prepared by the Institute of Transportation and Traffic Engineering at the University of California at Los Angeles.

#### Definitions

Average daily traffic: The total volume during a given time period in whole days greater than one day and less than one year divided by the number of days in that time period, commonly abbreviated as ADT. This indicator identifies the level of use on a segment of highway. It has implications for the level of development that a roadway will have.

Bicycle: A device propelled exclusively by human power upon which a person may ride.

**Bike lane with barrier:** A portion of a roadway which has been designated for exclusive use by bicycles. It is separated from the portion of the roadway for motor vehicle traffic by a physical barrier such as a curb or guardrail.

**Bike lane without barrier:** A portion of a roadway which is designated for preferential use by bicycles. It is distinguished from the portion of the roadway for motor vehicle traffic by a paint stripe or other pavement marking.

**Bike path:** A bicycle facility developed primarily for the use of bicycles and separated from roadways and pedestrian paths.

**Bike route:** A road marked for bicycle use but with bicyclists sharing the road surface with motor vehicles.

**Bicycle traffic volume:** The amount of bicycle traffic passing a given point on an average daily basis, figured over an average of 180 riding days per year. This is an indicator of the amount of usage a bikeway facility can be expected to have.

**Bikeway:** A term used to define all facilities that explicitly provide for bicycle travel.

**Clearway:** The area adjacent to the roadway which is kept as clear of obstacles as is possible. According to present standards, a clearway of 30 feet from the edge of the outside lane is desirable. If this clearway cannot be met, barriers must be provided to redirect an out-of-control motorized vehicle safely past the obstacle or a crash cushion must be provided to protect the motorist from the obstacle.

**Collector roads:** A system of roads which supplements principal arterials in providing travel movement. The major purpose of this system is to connect local street systems to principal and minor arterials. The secondary purpose is to provide access to property.

**Controlled access:** A term used in conjunction with road design. A controlled access road is one which allows no cross movements and allows entrances only at periodic intervals under conditions of minimal interference with traffic flow. Freeways are the highest classification of road development. Access control is complete in freeway designs. Therefore, all bicycle facilities within a freeway right-of-way must be separated from the roadway by a fence and must not cross entrance, exit or mainstream traffic.

**Cross traffic:** Any vehicle movement which conflicts with the straight line movement of traffic along a road or path, including traffic at intersections, from alleyways and driveways.

Equestrian: A rider on horseback.

Hiking: Vigorous walking for extended distances.

**Local street system:** A system of roads which is primarily used for access to property. Major traffic movements are discouraged. This system provides access from property to higher order systems such as minor or principal arterials.

**Metric System:** A system of measures based on the meter and the gram. Metric measures are placed in parenthesis after all measurements in this document in anticipation of the adoption of the metric system in the United States. The abbreviation for meter is m. The abbreviation for kilometers per hour is k.p.h.

Pedestrian: Any person afoot.

**Principal and minor arterials:** Roads which have substantial statewide or interstate travel. Major use of this type of road is to provide major travel movements. The provision of access to property is secondary and incidental. Most state trunk highways are of this classification.

**Right-of-way:** The area owned by the highway authority. The width of the right-of-way may vary widely depending on the level of development of the road and the inclusion of roadway accessories. (Rest stops, fencing, trails).

**Roadway:** The area of the highway right-of-way upon which motor vehicles normally travel. This may include the shoulders of the road.

**Roadway width:** This is an important part of the roadway design which indicates whether or not the road can accommodate a bikeway facility. If the clearances between the motor vehicle traffic and the bikeway traffic are not adequate, safety problems will develop.

**Rural section:** This is the roadway design preferred for highway construction. It includes wide right-of-ways, open ditches for drainage and a clearway of 30 feet from the edge of the outside lane. The alternate design is the urban section.

**Shoulder:** That part of the roadway which is directly adjacent to the regularly traveled portion of the roadway and is on the same level as the roadway. The shoulder may be pavement, gravel, or earth.

Ski Touring: The process of travelling over varied terrain upon skis.

**Snowmobile:** A self propelled vehicle designated for travel on snow or ice steered by skis or runners.

**Urban section:** Roadway design used in urban areas where the right-of-way width is restricted. Because of the restricted right-of-way, there is not enough room for ditches, thus necessitating curbs and gutters. The other alternate design is the rural section.

**Users:** These are the people who do or would make use of a bikeway. They have characteristics which help identify the kind of bikeway that is needed.

**Vegetation:** Trees and shrubs placed between a path and a roadway to shield the path from the unpleasant sounds and sights of the roadway.

#### **II. PLANNING**

#### Demand

The first step in the planning process is to identify and quantify the demand.

Law enforcement officials can identify areas and levels of conflict between bicyclist and motorist. Accident statistics can also help verify the need for bicycle facilities.

School officials can be very helpful in identifying the demand generated by their students. A good portion of the bicycling population attends colleges, technical institutes, high schools, or grade schools.

Planning personnel are often aware of the need for facilities in conjunction with an overall transportation or recreational plan. They can provide the perspective for the need as it fits within the area's development plan.

User groups express demands for facilities and can be extremely helpful in the development and implementation of a bicycle facility.

Surveys, however, are the best source for specific information concerning the actual extent of need and demand.

There are two ways to survey demand. One way is to attempt to count the actual trips made. This is extremely difficult to do because of the diversity of origins, destinations, and routes. After facilities have been built, this type of survey can be more effective in identifying the amount of facility utilization. This type of survey does not identify potential usership.

Perhaps the best method of identifying demand is a survey which is given to a sample of the population under controlled conditions to measure the amount of bicycling done and the attitudes of the respondents toward bicycling. The results are calculated and expanded to the rest of the population. This method allows a measurement of actual usership and potential usership.

#### Inventory

An inventory of existing facilities must be done early in the planning process. Present bicycle trails should be identified and catalogued. Roads and paths used for bicycle trips should be identified.

An inventory of potential facilities should also be done. The road system should be examined for bikeway development potentials. Abandoned railroad rights-of-way, utilities rights-of-way (power lines, pipelines, telephone lines) and other linear facilities (canals, rivers) should be examined for their potential capacity for bikeways.

#### **Need For New Facilities**

A comparison of the demand and the existing facilities will make it apparent if there is a need for more or better bicycle facilities and where the needs are. The needs of the bicyclist are not always to paint lines on the street or to build a separate path. Sometimes the needs are to provide a safe method of crossing a bridge, or a safe place to park their bicycles, or an asphalted shoulder along the road.

First, efforts should be made to improve the existing highway and street systems for bicycle travel.

If needs for bikeways cannot be met in this manner or if increased bicycle ridership indicates the need for further development, a master plan for a bikeway system should be developed.

#### **Master Plan**

If there is a need for bicycle facilities in the area, a master plan should be developed. This master plan should develop a system of facilities which provide for the needs of the commuting and recreational bicyclist. Special consideration must be given to provide safe facilities where heavy use by children is expected.

Location of bikeways depends on many factors. Perhaps the most important criterion to the commuting cyclist is whether bikeways go where he wants to go in a reasonably efficient manner. The less convenient a bikeway is, the less likely the cyclist is to use it.

A system of bikeways that join major trip generators is most likely to meet the commuters' needs. Some trip generators are schools, parks, shopping centers, libraries, and other public and commercial facilities.

For recreational purposes a bikeway should be planned to travel through a variety of pleasing environments: through parks, along rivers, down quiet residential streets, and past points of interest. All of these add to the quality of a bikeway.

It is difficult to balance all these requirements with safety factors and availability and emerge with a workable solution. Identification of the primary use of the facility (transportation, recreation) can ease the conflict between differing requirements and facilitate a solution.

#### Funding

Before any facility can be built, funding must be found. The type and amount of funding will influence the kind of facility that will be built and where it will be located.

Sources of funds for bikeways may come from many areas. Local sources of funds may come from general revenues, highway and street funds, recreational funds and donations from user groups. Existing sources of state and federal funds are discussed in Appendix A, "Trail Funding Sources."

#### **Priorities**

Under most circumstances the demand for facilities is greater than the ability to provide those facilities. Therefore, it is important to establish priorities.

Segments of the system that have the greatest usage should be built first. A monitoring of the levels of usage on these facilities can then help identify where future upgrading and development should be concentrated.

#### Construction

Construction standards are covered in detail later in this document. The construction of facilities to lesser standards than those recommended is strongly discouraged. Without proper construction, the bikeway will require increased maintenance resulting in additional expense. If the bikeway is not repaired it will lose usership because of surface decay.

#### Design

Good bikeway designs provide greater safety for bicyclists, but the ultimate responsibility for safety rests with the bicyclist, pedestrian and motorist. *Education and enforcement of safe highway practices are the key to the success of any bikeway.* The designs offered later in this document must be viewed within this context.

#### Evaluation

The development of bikeways should never end with the construction of a facility. *Periodic monitoring and evaluation of the facility must be done.* 

All facilities should be evaluated on criteria such as:

Does it attract any users?

Should it be upgraded to a higher level facility?

Are there any safety problems with it?

Does it conflict with adjacent land uses?

Are collateral facilities needed?

The answers to these questions will identify what is needed to make the facilities satisfy the need it was built to fulfill.

#### **III. DESIGN STANDARDS**

#### Geometrics

Bicycle and bicyclist dimensions. The following are considered average dimensions for the bicycle and bicyclist:

Handle Bar Width Cycle Length Pedal Clearance Vertical Space Occupied by Bicycle and Cyclist 1.96 feet ( .60 meters) 5.75 feet (1.75 m) .50 feet ( .15 m)

7.4 feet (2.26 m)

Vertical clearance. Based upon the vertical space occupied by a bicycle and bicyclist of 7.4 feet (2.3 m) overhead obstructions should be no less than 10 feet (3 m) from the surface of the bikeway.

**Bikeway widths.** The width of a bikeway depends on the amount of bicycle traffic, the available space and the maneuvering requirements of the bicyclist. The desirable widths for bike paths are: one-way bikeway 8 feet (2.4 m) two-way bikeway 10 feet (3 m). Figures 1-10 indicate appropriate widths for bike lanes on streets.

**Bikeway capacity.** Estimates of bikeway capacity indicate that as many as 1,500 bicycles per hour can be handled on a two-way, two-lane bikeway. That represents one bike passing a given point every 2.4 seconds.

**Bikeway design speed.** Although bicycles can be pedaled at speeds in excess of 30 m.p.h. (18.6 k.p.h.) most bicyclists travel at significantly lower speeds, averaging around 10 m.p.h. (6.2 k.p.h.). This figure is generally accepted as a conservative value for bikeway design purposes. Experimentation conducted in Davis, California, showed average bicyclist velocity to be between 10-11 m.p.h. (6.2-6.8 k.p.h.).

In the event that touring routes are developed apart from existing roads, a higher design speed should be used, perhaps as high as 25 m.p.h. (15.5 k.p.h.). Similarly, downhill curves should be adjusted to reflect the probable speeds that will be attained.

The type of surface used will also affect speeds. Concrete and asphalt have less drag because of their hardness. Softer materials such as limestone and earth produce more drag and therefore limit speeds.

**Sight distances.** The sight distance to any hazard or potential hazard must be a minimum of 50 feet (15.2 m) at 10 m.p.h. (6.2 k.p.h.) that allows 4 seconds to react to any obstacle or hazard. If this sight distance cannot be provided, warning signs must be posted.

Grade. Acceptable bikeway grades and the length of such grades depend to a great measure on the characteristics of the individual bicyclist and his equipment, wind velocity, bikeway surface, and other factors. Most literature recommends that bikeway gradients do not exceed 5% (except for very short distances).

For the modern bicycle equipped with gear changing mechanisms, more severe grades can be negotiated with less effort. However, for the middleweight bicycle without gear shifting capabilities or with only two or three gear ratios to select from, long uphill grades should be held to a minimum.

If difficult grade problems cannot be overcome, measures should include the provision of rest stops or lower grade "switchbacks." Table 1 shows some suggested relationships between grade and grade-lengths.

#### TABLE 1

Bikeway	Desirable	Normal	Maximum
Gradient	Length	Length	Length
10.0% 5.0 4.5 4.0 3.5 3.3 2.9 2.5 1.7 1.5	Not Recommended Not Recommended 82' (25 meters) 102' (31 m) 148' (45 m) 148' (45 m) 200' (61 m) 262' (80 m) 590' (180 m)	33' ( 10 meters) 131' ( 40 m) 167' ( 51 m) 203' ( 62 m) 295' ( 90 m) 295' ( 90 m) 400' (122 m) 525' (160 m) 1,180' (360 m) 2,100' (640 m)	66' ( 20 meters) 262' ( 80 m) 334' (102 m) 410' (125 m) 590' (180 m) 590' (180 m) 800' (244 m) 1,050' (320 m) 

#### **GRADE AND GRADE LENGTH CRITERIA**

NOTE: "Desirable" lengths include consideration of possible high wind conditions. "Normal" lengths represent gradient lengths judged acceptable.

SOURCE: California Division of Highways, Bikeway Planning Criteria and Guidelines, April, 1972.

**Radius of curvature.** In planning for bike paths, radii of curvature consistent with the design speed of the paths must be established.

Radius of curvature is generally not a consideration in regard to bikeways developed on existing road alignments since the existing design should be more than adequate for bicycles traveling at reasonable speeds.

Care must be taken, however, to avoid sharp angles and short radius curves when constructing bike paths, particularly at the bottom of a long negative grade where the velocity of a descending bicycle can be quite high.

According to the California Division of Highways in *Bikeway Planning Criteria and Guidelines,* the correct radius of curvature can be figured by this formula: R = 1.25 V + 1.5. R is the radius of curvature in feet and V is the velocity in miles per hour. The application of a bikeway design speed of 10 m.p.h. (6.2 k.p.h.) to this formula results in a computed radius of curvature of 13.9 feet (8.6 m). Curves may need to be widened by as much as 4 feet (2.5 m) to satisfy the need for greater maneuvering width.

#### **Classification Of Bicycle Facilities**

There are three different levels of bicycle facility development which differ in cost, visability, location, safety and desirability.

**Bicycle routes.** Routes are the least costly, least developed, and most easily provided type of facility. Bicycle routes are placed on a low volume, low speed roadway, which is shared by motor vehicles and bicycles and which is identified specifically for bicycle use.

The purpose of a bicycle route is to identify for the bicyclist roads which are safe to use.

**Bicycle lanes.** Bicycle lanes are a part of a street or road designated for the use of bicycles. Separation of bicycle traffic from automobile traffic is achieved. Lanes are more costly than routes.

The primary use of bicycle lanes is for transportational trips on or parallel to major arterial streets, to such areas as employment centers, shopping areas and schools.

**Bicycle paths.** Bicycle paths are the highest form of bicycle facility. They are completely separated from the roadway and are out of the direct influence of the vehicle traffic.

Bicycle paths may be completely disassociated from the highway or they may be placed within the highway right-of-way but outside of the clearway.

The primary use of bicycle paths is recreational in nature though significant transportational usage may be identified.

Because of the need for right-of-way (except in highway right-of-way) and the need to construct totally new surfaces, the cost of bicycle paths can be expensive when compared to other bicycle-way facilities.

#### Warrants

The decision concerning the type and level of bicycle facility appropriate to any situation depends on several factors. Any bikeway facility built must be safe: It must also be used enough to justify the cost and must not unduly infringe upon the safety and capacity of the highway system.

The safety of a bikeway on a roadway may be predicted by motor vehicle and bicycle traffic volumes, the design of the roadway, and the speed of the motor vehicle traffic.

The following descriptions are of measurements that may be used to evaluate roadways for the inclusion of bikeway facilities.

Average daily traffic (ADT). Although no standard has been set, it is generally accepted that any trunk highway having an average daily traffic of 5,000 to 6,000 or more should be considered for upgrading from a two lane to a

four lane facility. There are, however, many other factors included in such a decision. Peak traffic volumes, road design capacity, design speeds, and safety statistics are all important in the consideration of a road upgrading. They are also important in the consideration of the inclusion of a bikeway within the highway right-of-way.

**Bicycle traffic volume (BTV).** The BTV should be calculated on a 180 day riding year. In Minnesota, the weather between October and March cannot be considered conducive to bicycle riding.

Special attention should be given to the peak traffic needs of the cyclist. Peak traffic is affected by the weather and time of the week. An afternoon on a beautiful spring weekend will attract greater bicycle traffic than that indicated solely by the BTV.

As bicycle trail facilities are built and traffic volumes become easier to identify, this indication should be re-evaluated to more closely resemble the ADT for motor vehicles.

This indicator must be considered along with the cost effectiveness of the bikeway facility and the safety factors involved.

**Motor vehicle speeds.** The greater the motor vehicle speed the greater the safety problems of including a bikeway on the roadway. High motor vehicle speeds mean that there is a great disparity between the speed of the bicycle and the speed of the motorized traffic. As speed increases, the amount of reaction time is decreased creating the need for greater clearways.

Posted speed limits and measured speed characteristics of motor vehicles are both indicators of speed levels on a roadway.

The 85 percentile average speed is a good indicator of the actual speeds on the roadway but posted speed limits are a method of controlling motor vehicle speeds if rigidly enforced.

On trunk highways, speed limits are set based on traffic investigations that take into account potential and existing hazards such as pedestrians, bicycles, etc. Thus, the introduction of a bikeway facility on a trunk highway would be the basis for a review of the speed limits. This review would take into account the potential hazards of the bikeway both to motorist and bicyclist.

Minnesota Statutes 1973, Section 169.14 establishes speed limits throughout the State and establishes the procedure for special speed zoning.

Appropriate local authorities may submit a request to the Commissioner of Highways for a change of speed limit. Thus, the authority (such as a city) may request a speed change if bikeways are placed on a street and conflicts between bicycles and motor vehicles are anticipated.

**Bicycle route warrants.** Because of the low cost and ease of identifying routes with signs, the bicycle route is ideal as the initial step in the development of a bikeway network. Route locations can be changed easily if needed and the more heavily traveled segments can be upgraded to a higher level facility such as a lane or path.

In rural areas where a multitude of low traffic volume roads are available, routes are the most common and feasible alternative.

#### TABLE 2

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Road Design	Road Functional Classification	Number of Lanes	Average Daily Traffic	Bicycle Traffic Volume
Urban Road Design On	Principal and Minor Arterials	Multi- Lane 2 Lane	≤8,000 ≤4,000	≤100 ≤100
	-			
	Collector Roads	2 Lane	≤4,000	≤100
	Local Streets	2 Lane	≤1,000	≤100
Rural Road Design On	Principal and Minor Arterials	2 Lane	≤2,000	≤100
	Collectors Roads	2 Lane	≤2,000	≤100

#### **BICYCLE ROUTE WARRANTS**

Special provisions for bicycles consist of signs to identify the route and to warn motorists of the presence of the bicyclist.

Bicycle routes should be placed only on highways with low average daily traffic volumes.

If 100 or more bicycles use the route daily, an evaluation of the safety of the route should be made. A usership of 100 bicyclists indicates that a higher grade facility may be economically feasible. In all cases safety and useability must be the prime considerations.

A large part of the success of a bicycle route is having it go where the users want to go, having it placed on a road with a good, smooth surface, and having it on a road that is wide enough to allow motor vehicles to pass the bicyclist without crowding.

There must be a shoulder of some sort available for routes whether or not it is surfaced. The shoulder should be at least four feet wide to give the bicyclist an area of retreat in emergencies. Table 2 shows recommended warrants for bicycle routes on highways.

**Bicycle lane warrants.** There are two ways of separating the bicycle lane from the road: by using a psychological barrier such as a striped line or a physical barrier such as a curb.

The bicycle lane without a physical barrier is considered to be a more sophisticated development than the bicycle route. The cost associated with a bicycle lane without a physical barrier is relatively low, although it is higher than the cost of a bicycle route.

The success of bicycle lanes without barriers depends on establishing respect for the bicycle lane. This can only be accomplished through a concerted effort to educate and enforce the rules of the road for both the bicyclist and the motorist.

Table 2 shows recommended warrants for bicycle routes on highways.

Parking should be removed entirely from the side of the street upon which a bicycle lane has been placed (unless barriers are used). This will aid in defining the bike lane as an area where motor vehicles are not allowed. It will also assure adequate space for the lane and minimize automobile-bicycle conflicts.

During the initial few weeks after the opening of a bike lane there should be a concerted effort to provide enforcement which will guarantee the proper use of such lanes. Closely monitoring the use of facilities will indicate if extra signs are needed or if some physical modification should be made to correct a tendency to misuse the lane. "No Parking" signs may be needed. Even a temporary construction barrier may be needed at intersections to guide motorists out of the bicycle lane.

Bicycle lanes should be placed one on each side of a two-way road adjacent to the traffic lanes with bicyclists traveling in the same direction as the automobile traffic. The placement of a two-way lane on one side of the road is strongly discouraged.

On one-way streets the bicycle lane may be placed on either side of the road, but bicyclists must travel in the same direction as the automobile traffic. These lanes will preferably be placed on the right side of the road for purposes of uniformity.

Whenever possible, a bicycle lane should be placed on a residential street. Information signs limiting parking on the right side of the street, and providing stop signs to control cross traffic are methods for improving the desirability of such a lane for bicycles. If the street runs into a park or other natural obstruction that can be crossed by bicycles, this increases the separation between the bike lane and the vehicle lane. Table 3 shows recommended warrants for bicycle lanes without barriers.

The bicycle lane with barrier is the highest level bicycle facility that can be placed on the roadway.

The cost of the barrier makes the bicycle lane with a barrier an expensive alternative. This expense is justified only in urban areas where demand is high, danger is great, and space is at a premium. Experience with such barriers has shown that they tend to be hazardous to bicycle operation and obstruct maintenance operations, particularly snow removal. In rural areas, paths usually provide a safer, more economical alternative than lanes with barriers.

#### TABLE 3

#### BICYCLE LANE WARRANTS (without barrier)

Road Design	Road Functional Classification	Number of Lanes	Average Daily Traffic	Bicycle Traffic Volume
Urban Road Design	Principal and Minor	Multi- Lane	≤20,000	≤200
Un	Arterials	Z Lane	≤ 6,000	≤200
	Collector Roads	2 Lane	≤ 6,000	<mark>≤2</mark> 00
	Local Streets	2 Lane	≤ 1,000	≤100
Rural Road Design	Principal and Minor	Multi- Lane	≤14,000	≤200
On	Arterials	2 Lane	≤ 6,000	≤200
	Collector Roads	2 Lane	≤ 3,000	≤200

#### TABLE 4

#### BICYCLE LANE WARRANTS (with barrier)

Road Design	Road Functional Classification	Number of Lanes	Average Daily Traffic	Bicycle Traffic Volume
Urban Road Design	Principal and Minor	Multi- Lane	≥20,000	≥200
On	Arterials	2 Lane	≥ 6,000	≥200
	Collector Roads	2 Lane	≥ 6,000	≥200

A curb should be used to separate the bike lane from traffic when the ADT is between 6,000 and 20,000. For ADT's of greater than 20,000, a traffic barrier must be used. (See barrier section for descriptions.)

Table 4 shows recommended warrants for bicycle lanes with barriers.

**Bicycle path warrants.** Bicycle paths are usually the most expensive bikeway facility; they are also the most desirable. Bike paths may be within the highway right-of-way or outside the highway right-of-way. If they are within the right-of-way, they must be completely separated from the roadway.

To the greatest extent possible, the path within the highway right-of-way should be placed outside of the 30 foot (9.1 m) clearway that the Highway Department attempts to maintain along the side of the roadway. 80% of all vehicles that leave the road stay within this 30 foot (9.1 m) clearway. When the path advances within the 30 foot (9.1 m) clearway along a high speed, heavily traveled highway, consideration should be given to providing a guardrail or other barrier between the highway and the bicycle path even though a guardrail is a hazard in itself both to the motorized vehicles and the bicycles.

Two-way bicycle traffic is allowed on bicycle paths unless bicycle traffic volume indicates that it would be unsafe.

#### **TABLE 5**

Road Design	Road Functional Classification	Number of Lanes	Desirable Average Daily Traffic	Desirable Bicycle Traffic Volume
Urban Road Design On	Principal and Minor Arterials	Multi- Lane 2 Lane	> 20,000	>200 >200
	Collector Roads	2 Lane	> 6,000	>200
Rural Road Design On	Principal and Minor Arterials	Multi- Lane 2 Lane	>14,000 > 6,000	>200 >200
	Collector Roads	2 Lane	> 3,000	>200

#### **BICYCLE PATH WARRANTS**

When the path crosses a road, the crossing should be made away from any roadway intersections so that all vehicle traffic will approach along one roadway. If needed, a Hazard Identification Beacon should be installed.

Pedestrian traffic is usually allowed, although discouraged, on the path unless a separate pedestrian path is provided. Bicycle traffic volumes and pedestrian volumes will dictate the need for separate facilities.

Because of the cost of providing a separated bike path, a bicycle traffic volume of 200 or more along a corridor should be identifiable. Motor vehicle traffic volume should be high and present a real safety hazard.

A bicycle path may be needed only for a short stretch to bridge a hazardous area. Table 5 shows recommended warrants for bicycle paths.

#### **Bicycle Lane Configurations**

There are several alternatives in the placement of lanes on a roadway. The two major types of lane configurations are lanes without barriers and lanes with barriers (includes lanes on boulevards).

Lanes without barriers must be placed on streets with enough width to allow the inclusion of two one-way lanes without cramping the vehicle traffic lanes. In most cases this means that parking must be banned. The minimum width for a street, with bike lanes and no parking, is 36 feet (11 m). This allows two twelve-foot (3.7 m) traffic lanes and two six-foot (1.8 m) bicycle lanes. Bike lanes of 4 feet (1.2 m) may be used if minimum traffic and bicycle volumes are expected, (See Figure 1.)

#### **FIGURE 1**

#### **BIKE LANE WITH NO PARKING**



Lanes on 44 foot (13.4 m) wide streets, that have low traffic and parking volumes may allow parking within the lane. The bike lanes must be 10 feet (3 m) wide and the traffic lanes must each be 12 feet (3.7 m) wide. This alternative may be used where heavy commuter traffic is expected and parking is prohibited during rush hours. (See Figure 2.)

#### FIGURE 2



#### **BIKE LANE WITH PARKING IN LANE**

On 48 foot (14.6 m) wide streets both parking and bike lanes may be placed on both sides of the street. The bike lanes should be 4 feet (1.2 m) each in width and placed between 8 foot (2.4 m) parking lanes and 12 foot (3.7 m) traffic lanes. This alternative is not recommended in most cases. Cars crossing to park, opening car doors, and pedestrian cross traffic all increase the safety hazard of this alternative. Also experience has shown that the cars tend to park close to the pavement marking instead of close to the curb. This alternative may also be used on multi-lane facilities but only if no better facility is available or feasible. (See Figure 3.)

If possible, bike lanes should be placed on low volume residential streets. No striping is required and parking may or may not be allowed based on space requirements. Motor vehicle traffic and bicycle traffic may be allowed to mix. (See Figure 4.)



**FIGURE 4** 

PREFERENTIAL BIKE STREET



LEGISLATIVE REFERENCE LIBRARY STATE OF MINNESOTA Bike lanes on one-way streets should be 8 feet (2.4 m) in width, travel in the same direction as the motor vehicle traffic and should not be adjacent to a parking lane. One-way streets are usually developed in pairs so that one bike lane may be placed on each of the one-way streets. (See Figure 5.)



Lanes on rural highways should be placed on the shoulder of the highway. For most highways, the shoulder should be 10 feet (3 m) wide. On low volume roads, the shoulder may be as little as 4 feet (1.2 m) per side but that width is not recommended. Emergency use of the shoulder for motor vehicle breakdown may be allowed. (See Figure 6.)

#### FIGURE 6

#### RURAL BIKE LANE ON SHOULDER OF ROAD



Right turn traffic lanes should not be imposed on the bicycle lane. If right turn lanes are needed, the bicycle lane should be routed around the right turn lane. (See Figure 15b.)

Bicycle lanes with barriers may be placed on the shoulder of an urban street or road or on the boulevard adjacent to the curb.

The most common bike lane with barriers is placed on a street with parking prohibited on both sides. The bike lanes should each be 8 feet (2.4 m) wide and each traffic lane should be 14 feet (4.3 m) wide. (An extra 2 ft. reaction distance is required.) For low speed roads, a portable curb may provide a sufficient barrier between the bicycle lane and the traffic lane. (See Figure 7.)



On higher speed roadways with heavy motor vehicle traffic volumes, barriers such as a concrete barrier are needed. This alternative is extremely expensive and should be used only when no feasible alternative exists. The bike lanes should be 8 feet (2.4 m) wide. Each traffic lane should be 12 feet (3.7 m) wide and a reaction distance of 4 feet must be provided between the traffic lane and the barrier. (See Figure 8.)

If parking is to be allowed, the bike lane should be placed between the curb and the parking lane. Bike lane width may be as narrow as 4 feet (1.2 m).

Parked motor vehicles will help provide a safe barrier between the bicycle lanes and the motor vehicle traffic lanes. There will still be the problems of opening car doors, pedestrian traffic across the bike lane and, if parking meters are used, where to place them.

Safety on this type of bike lane is generally good although some hazard is encountered by parked cars shielding the bicyclist from view at intersections and from cars turning into driveways. (See Figure 9.) Bike lanes on one-way streets should be 8 feet (2.4 m) in width, travel in the same direction as the motor vehicle traffic and should not be adjacent to a parking lane. One-way streets are usually developed in pairs so that one bike lane may be placed on each of the one-way streets. (See Figure 5.)



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Placement of bike lanes on the boulevard alleviates the pressures for space on the roadway but conflicts with pedestrian traffic. This type of facility is most appropriate in low pedestrian traffic areas.

If pedestrian traffic is anticipated, separate facilities should be provided.

Special effort should be taken to identify the bicycle lane as being for bicycles only and the pedestrian lane for pedestrians only. If the path is shared, there should be no special markings unless warning signs are posted.

To aid in separating pedestrian and bicycle lanes, vegetation and as much space as is feasible should be placed between the two facilities. (See Figure 10.)



A distinction should be made between allowing bicycles to use sidewalks by local ordinance and designating a sidewalk as a bikeway. In the latter case, the designation implies a recommendation to use a particular sidewalk. This in itself may generate demand. Thus, the use of sidewalks by bicycles is considered a status-quo alternative.

#### Location Of Bikeways Within The Highway Right-Of-Way

If bicycle lanes and paths are going to be placed within the highway right-of-way some modification of the roadway design will be necessary. The primary need for modification is on bridges and underpasses.

Design recommendations are made for the modification of existing facilities and for the modification of new facility design. Bridges, underpasses, and approaching roadways are shown for urban and rural sections. (See Figures 11, 12, 13.)

The major need for modification in the placement of lanes is the widening of bridge decks. Bicycle lanes on existing roads having bridge shoulder width of less than 4 feet (1.2 m) will require the construction of a supplementary bridge. (See Figure 14.) In most cases, the cost of widening an existing bridge is as costly as building a separate pedestrian type bridge. New bridges normally have shoulder widths of at least 10 feet (3 m). (See Figure 11.)

Bicycle lanes on underpasses should need no modification if the shoulder of the highway is paved and is 10 feet (3 m) wide. (See Figure 12 and 13.)

Bicycle paths require more modifications. Bicycle paths on existing bridges should be diverted to a separate pedestrian type of bridge (Figure 14) unless there is a separated sidewalk along the shoulder of the bridge. Any path next to the roadway on a bridge must have a traffic barrier and a restraining chain link fence between the traffic and the path. Provide a chain link fence between the path and the outside edge of the bridge. (See Figure 11c, d.) This fencing is a precaution against the danger of the bicyclist falling over the traffic barrier or









the handrail on the outside. Bicycle paths on new bridges should have at least a 10 foot (3 m) roadway shoulder separating the bicycle path from the roadway. A barrier and fencing should also be included. (See Figure 11c, d.) If the cost of this type of bridge expansion is as great as the cost of a separate pedestrian type of bridge, the separate bridge should be built. (See Figure 14.)

Bicycle paths may be placed through underpasses on existing roads if the path does not need to cross exit or entrance ramps. (See Figure 12a, b, and 13 a, b, c.) If exit or entrance ramps are present, the path should be built to circumvent them.

The placement of paths through existing underpasses involves the placement of a culvert along the bottom of the ditch and filling the ditch in so that the path may be built on top of the culvert. (See Figure 13a, b.) Some portion of the area outside the shoulder of the road must remain lower than the shoulder so that water may still flow without flooding over the roadway if the culvert becomes plugged. (See Figure 13a, b.)

The path should be placed outside the 30 foot  $(9.1 \cdot m)$  clearway, (see Figure 12a, c, d, e, and Figure 13a, d, e) or outside of the support columns and behind a guardrail. (See Figure 12b and 13b, c.)

Bicycle paths developed in conjunction with a new road may be placed on an underpass in the same manner as for paths under existing underpasses. The path may, however, be placed at the base of the bridge abutment at least 30 feet away from the outside edge of the traffic lane. (See Figure 12c, d and 13d, e.) In this manner normal drainage flow can be maintained. Vertical clearance of at least 8 feet (2.4 m) must be maintained on all underpasses.

All bicycle paths on controlled access highway rights-of-way must be fenced. The fence should be placed 30 feet (9.1 m) away from the edge of the outside traffic lane and, if possible, 2 feet (.6 m) or more from the edge of the bike path.

On bridges and underpasses, the fencing should be directly adjacent to the bicycle path.

#### Intersection Design

By far the most crucial part of any bikeway design is that associated with the intersection. It is at this point that the potential for conflict is the greatest. It is, therefore, imperative that careful thought be given the placement of bikeways through intersections.

The possible automotive and bicycle movements, and the difficulty of clearly perceiving where the conflict will arise makes the hazard a very serious one. The bicyclist's view range is about 180°. Anything behind him is, for all practical purposes, unidentifiable. Automobiles generally do not encounter hazards from the rear because they are able to move along with the flow of traffic, are easily seen, and occupy the central position on the roadway.

Bicycles, on the other hand, are less capable of maintaining the speed of traffic flow. This means that they are continually being overtaken from behind. They must travel to the right which takes them out of the central focus of the motorist's view.

In crossing an intersection the bicyclist encounters several potential conflict areas. These danger points must be minimized to allow the motorist and bicyclist to respond to each other safely.

Bicyclists wishing to make a left hand turn face the possibility of conflict with all four directions of traffic.

The safest method of accomplishing a left turn is to continue across the intersection with the traffic and then complete the turn by crossing as a pedestrian with the green light if a semaphor is present.

All intersections through which a bicycle lane passes must have traffic controls. The type of control depends on the traffic volume of streets involved and the amount of bicycle traffic. Caution must be taken, however, to assure that the provision signs and controls actually increase safety. They may do nothing to protect the bicyclist while giving him a false sense of security.

Bike lanes through intersections lend themselves to channelization. There is some debate as to the effect of continuing bike lanes through the intersection. Some bikeway planners feel that bike lanes in the intersection restrict the freedom of the bicyclist to make turning movements and provides a false sense of security to the bicyclist who feels he has safety from right turning motorists. Other bikeway planners maintain that there must be a mechanism to guide the bicyclist through the intersection and the lane gives the bicyclist the right-of-way over right turning automobiles. In the absence of a technical or statutory solution to this debate, it is recommended that lanes not be continued into the intersection.

If lanes are to be continued through the intersection, they should be placed in a manner similar to those shown in Figure 15. Figure 15 shows three model intersections with bike lanes included. The first illustrates a bike lane passing straight through the intersection. The second one shows the lane circumventing a right turn lane and the third illustration shows the manner in which a lane may make a turn at an intersection.

The methods of striping lanes are indicated in Chapter V on Signing.

When bicycle paths must cross a roadway, they should be done at a 90° angle with appropriate warning signs for motorist and bicyclist. It is recommended that the path crossing should be at least 200 feet (61 m) from any intersection at roads. If this is not possible, the path should cross within 30 feet (9 m) of the intersection. This will insure that bicycle crossings on the path will either be part of the intersection or completely out of the influence of the intersection. If motor vehicle traffic is extremely heavy and path usage is high, a Hazard Identification Beacon may be appropriate. If funds are available a bridge over the road would greatly increase safety.


## **IV. CONSTRUCTION STANDARDS**

# **Path Surface Construction**

Of prime concern in the construction of a path surface is the subgrade soil characteristics. A soil survey should be done to identify the types of soils present.

The purpose of the detailed soil survey is to provide soil information needed to make recommendations for grading, bases and surfacing to the designer.

Periodic auger borings should be taken along the proposed location. Where non-uniform soils are encountered, boring interval distances should be decreased. Borings should be taken to depth of 5 feet (1.5 m) below natural ground in fill sections. At least one boring in each fill section should extend to a depth equal to the height of the proposed fill.

In problem areas, such as swamps and rock sections, boring interval distances should be decreased and additional borings should be taken on the cross-sections as needed.

Subcuts and soil selections are, of necessity, handled on an individual basis for each project. Soil survey data should be reviewed by a competent soils engineer. The extent of subcuts and soils selection should be determined prior to selecting a soils classification and/or R-value for design purposes. An R-value is an empirical measure of soil strength used to classify soils for pavement design purposes.

The soil engineer should also determine the need for a soil sterilant. To prevent the growth of weeds, it is good practice to sterilize the subgrade soil before placement of the layers of pavement for all off-street paving. Commercial sterilants are available that will prevent the germination of weed seeds in the subgrade. Care should be taken to follow the manufacturer's recommendations for handling and application, and to comply with any laws, ordinances, or regulations governing the use of such chemicals.

In the design of the bicycle path surface the total structure must be taken into account. The subgrade, pavement bases and wearing course are all important to the durability of the path. Asphalt and Portland cement are the smoothest, most long lasting surfaces. Gravel, stone, and limestone are popular choices, particularly for recreational types of bike paths. Dirt and turf are the surfaces for informal types of paths. The cost of these surfaces are directly related to their permanency.

Of the possible choices, asphalt is recommended. Asphalt provides smoothness, durability and ease of maintenance. If the initial cost of asphalt makes the construction of a bikeway too expensive, it is possible to lay a gravel or stone path which can be surfaced later. The asphalt base may be placed first as a temporary measure and then within 2-3 years a wearing course may be added. It is stressed that this type of stage development must be completed to assure a quality bike path.

# TABLE 6

# RECOMMENDED STANDARDS FOR BICYCLE PATH CONSTRUCTION

			Recommended Minimum Layer Thickness			
					Wearing Course	
Quality of Existing Subgrade	Material AASHO System	Minimum Total Thickness In G.E.	Full Depth Asphalt Spec. 2331 Wearing Course (2.00 G.E. Factor)**	Asphalt Base Spec. 2331 (2.00 G.E. Factor)**	Spec. 2331 (2.00 G.E. Factor)**	Spec. 2361 (Modified)*** (2.25 G.E. Factor)**
Very Good (R`> 50)	Gravels & Sands A-1, A-2-4, A-2-5 & A-3	6 in. (15.24 cm)	3 in. (7.62 cm)	3 in. (7.62 cm)	1½ in. (3.81 cm)	¾ in. (1.9 cm)
Good (R = 15 to 50)	Silts & Clays A-4, A-5, A-6 A-7-5 & A-7-6	8 in. (20.32 cm)	4 in. (10.16 cm)	3 in. (7.62 cm)	1½ in. (3.81 cm)	¾ in. (1.9 cm)
Poor* (R < 15)	Silts & Clays A-4, A-5, A-6, A-7-5 & A-7-6	12 in. (30.48 cm)	6 in. (15.24 cm)	3 in. (7.62 cm)	1½ in. (3.81 cm)	¾ in. (1.9 cm)

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# TABLE 6 (continued)

Notes: \* - Silts and clays fall into this poor category when they occur in low lying areas near the water table or anywhere poor drainage causes an excessive supply of moisture.

\*\* - Parenthesized numbers are the gravel equivalent factors of the asphalt material.

\*\*\* - The aggregate in this mix shall be modified to consist of sound, durable particles of gravel sand, crushed stone, slag or combinations thereof. If the aggregate consists of crushed limestone or slag, sand shall be added in amount equal to at least 20 percent of the weight of the total aggregate. It shall be free from loosely bound aggregations, clayey lumps or other objectionable matter.

The shale content of the material shall not exceed 5% by weight of total sample.

Final acceptance of the aggregate for use will be on the basis of trail mix results using procedures on file with MHD with the following criteria being met within the range of asphalt content specified in 2361..3E1:

1. Stability in excess of 300 lbs.

2. Voids in mixture within range of 1 to 5 percent.

3. Cold - water abrasion loss less than 15 percent.

Table 6 recommends minimum standards for bicycle path construction based on a gravel equivalent measure. Gravel equivalent (GE) is the thickness of pavement required if it were to be constructed completely of gravel.

Full depth asphalt construction is recommended in areas of poor drainage and should be strongly considered in other situations because of the ease of construction. Where construction procedure permits, two lift construction will allow for a amooth even surface, free of water collecting depressions. *However, in areas where accessibility is limited it is recommended that one layer total asphalt construction be used with a MHD specification 2331 wearing course mixture.* 

Where two lift construction is possible it is recommended that a  $\frac{3}{4}$  inch (1.90 cm) MHD specification 2361 (modified) mixture wearing course or a  $1\frac{1}{2}$  inch (3.81 cm) MHD specification 2331 wearing course be used. Both have a high asphaltic content, have low maintenance cost and provide a smooth riding surface.

If bikeways are to be constructed as shoulders on a highway or street, those shoulders must be built to the standards of the highway.

Provisions for drainage of surface water must also be considered in the preliminary stages of design. Two methods may be used to accomplish this drainage.

1. Allow run-off to cross the trail and follow the same overland pattern as it did previously. This would require building the path to slope one-way rather than building it with a crown.

2. Provide ditches along-side the path and cross culverts as needed under the path.

The type of drainage facilities desired will depend on topography, soil types and erosion problems and should be designed on an individual project basis.

## **Bicycle Routes and Lane Surfaces**

When the bicycle shares an existing roadway, the provision of a separate surface is not necessary. However, there are modifications to the existing roadway surface that will greatly improve the quality of the road for bicycling.

Filling and smoothing holes in the surface improves the quality of the surface. If there are too many repairs a total resurfacing should be considered. All railroad crossings should be smoothed where they intersect bicycle facilities even though total removal of the washboard effect may not be possible.

Catch basin castings that have the openings parallel with the roadbed should be modified so the openings are at a 45 degree angle.

Periodic clearing of the bicycle surface is important to assure the removal of glass, rocks and other safety hazards.

## **Contract for Construction**

All contracts for bikeway construction within the highway right-of-way should follow the Minnesota Highway Department's standard specifications for highway construction.

#### **Drainage Grate Hazards**

While existing drainage systems incorporated into road rights-of-way are normally sufficient for both bike lanes and bike routes, exposed drainage grates can be hazardous. The danger lies in the possibility of the bicycle wheel becoming entrapped in the exposed grate.

Side-opening storm drains are recommended, where feasible. However, when only grates are feasible, their design should be zig-zag, perpendicular or diagonal to bicycle movement, to prevent danger. Cross strips may be attached to existing unsuitable grates, but care must be taken when modifying drainage grates, since their design is generally based on hydrodynamic principles.

The grate casting design which is recommended is Minnesota Highway Department grate casting No. 811. It is shown in Standard Plate No. 4151 (Spec. Ref: 2506). It has its openings at a 45 degree angle to the curb and is not likely to trap a bicycle tire in its openings. (See Figure 16.)

## **Curb Cuts and Ramps**

It may be necessary to direct a bikeway onto or off of a roadway requiring the negotiation of a curb. In the event of the need for a curb cut, the designs shown in Figures 17 and 18 are recommended.

# FIGURE 16 RECOMMENDED DRAINAGE GRATE DESIGN







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For curb ramps allowing transition from sidewalk to street the recommended standard is the Pedestrian Curb Ramp. It is shown on Minnesota Highway Department Standard Plate No. 7036 (Spec. Ref. 2521; 2531).

A modification of this standard is an expansion of the width of the ramp to equal the width of the bikeway. The shown width is 4'0'' (1.2 m); it may more properly be 8'0'' (2.4 m). (See Figure 19.)



#### **Barriers**

There are several types and uses of barriers. The following is a discussion of the kinds of barriers that can be used in conjunction with bikeways.

**Traffic barrier.** Typical traffic barriers are shown in Figure 20. These barriers are designed to steer automobile traffic away from hazards. The purpose of this kind of barrier is to absorb an impact from an automobile when it has left the roadway.





In relation to the bikeway, this type of barrier should be used to separate bikeways from roads with high volumes of traffic, high speed traffic, and hazardous areas.

The cost of this type of barrier is too prohibitive to use for long stretches. Serious consideration should be given to an alternate location of the bicycle facility if this type of barrier is needed.

The recommended barrier designs are: Structural Plate Beam Guardrail, MHD Standards Plate No. 8307 (Spec. Ref. 2554; 3306; ASTM A123) Figure 20a or 3 Cable Guardrail, MHD Standard Plate No. 8330 (Spec. Ref. 2554) Figure 20b or concrete barrier, no MHD standard, Figure 20c. Modifications to these designs are: if the barrier is placed within two feet of the edge of the bikeway, an additional rail should be placed on the side facing the bikeway to protect the bicyclist from any exposed bolts and the hazard of running into the anchor posts.

**Fencing.** This kind of barrier is used primarily to prohibit pedestrians and animals from controlled access roadways. Fencing must be placed between bicycle paths and controlled access facilities such as freeways. Fencing also is used to protect pedestrians and bicyclists when crossing an overpass or pedestrian bridge.

In urban areas, chain link fencing is preferred. Minnesota Highway Department standard for Chain Link Fence, Standard Plate No. 9322 (Spec. Ref. 2557) should be followed for all urban fencing.

In rural areas, the less expensive woven wire fencing is used. It is shown in Minnesota Highway Department Standard Plate No. 9320 (Spec. Ref. 2557).

**Vegetation.** Trees and bushes can be used for beautification and as visual barriers. Vegetation can shield the bicycle path from the noise and sight of the roadway. A hedge grown between the road and bicycle path can provide an effective physical separation, serving the same purpose as a fence.

**Curbs.** This is a barrier that can be effectively used on lower speed roadways. A curb may be a portable concrete barrier laid between traffic and the bicycle lane (Figure 21a) or it may be the edge of a grade separation (Figure 21b).

The curb acts as a physical deterent to the automobile but will not redirect an automobile that is out of control.

While the cost of this kind of barrier is significant, it is much less expensive than the traffic barrier.

A major problem with having a concrete curb on the street is maintenance. Snowplows find it extremely difficult to operate if the curbs are not removed during the winter. Removal and relaying of the curbs every fall and spring would greatly increase the yearly cost of the facility.

If cars are allowed to park along the curb between the vehicle traffic and the bicycle lane the safety of the lane can be enhanced. Care must be taken to assure that bicycles can safely pass around open car doors.

The recommended curb design is found in the highway department standards in the concrete curb and gutters design, Standard Plate No. 7100 (Spec. Ref. 2531). The recommended curb design is B624. This curb is to be used at the edge of the roadway for separation and drainage (Figure 21b).

The other type of curb, the portable curb is not included in present standards. The following illustration (Figure 21a) is of the recommended portable concrete curb to be placed on the roadway between the bikeway and the vehicle traffic lane.

# FIGURE 21 RECOMMENDED CURB DESIGNS

a. Portable Concrete Curb

## b. Concrete Curb and Gutter





# **V. SIGNING**

There are three types of signs needed on bicycle facilities.

1. Identification and reassurance markers:

These signs identify the facility, help the user to distinguish it from other routes, and reassure the user that he is still on the right trail.

2. Warning markers:

These signs identify hazards along the route such as "bumps," "stop ahead," "watch for pedestrians," flashing warning lights, and many others.

3. Regulatory markers:

These signs provide control over the use of the facility. Some regulatory signs are "stop," "yield," "no bicycles," and "no parking."

The following signs are more commonly associated with bicycle facilities. They have been taken from the Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways. All signs used on bicycle facilities should conform to the guidelines provided for signing in this manual.

Scaled down highway warning and regulatory signs may be used on bicycle paths until a nationally accepted bikeway signing system can be adopted.

# Identification and Reassurance Signs



Use: identifies bike routes and advises motorists of the presence of bicycle traffic.

Colors: standard interstate green, white.

Dimensions: 24" x 18".

Design: Bicycle symbol; the words BIKE ROUTE in 3" series C letters.

Placement: Urban: near the beginning of every other block.

Rural: at all points of decision, at least three signs per mile for reassurance.

Supplementary signs:

Directional arrow: used to indicate route direction.

Begin: used to identify the beginning of a route.

End: used to identify the end of a route.

Colors: standard interstate green, white.

Dimensions: 24" x 6".

Design: Begin or End in series C letters.

Placement: directly beneath and in conjunction with the bike route sign, as needed.

Warning Signs



Use: warns motorist of a bikeway crossing area. Colors: standard highway warning yellow, black.

Dimensions: 30" x 30" and 24" x 18".

Design: Bicycle symbol on diamond, BIKE XING on rectangle in series C letters.

Placement: 1/2 block from bikeway crossing.

Hazard Identification Beacons (Flashing Electric Lights). A Hazard Identification Beacon is a flashing yellow signal light (minimum diameter 8 inches) used at points of special hazard as a means of calling drivers' attention to these locations. When used, the flashing beacon should operate 24 hours a day.

This warning device may be used at bikeway and trail crossings where heavy trail use is experienced to warn motorists of a special hazard. If the trail use is seasonal, the warning signs should be removed at the end of the trail user season.

# **Regulatory Signs**



Use: prohibits bicycles from pedestrian paths and highways where bicycling is inappropriate.

Colors: standard highway white, black, red.

Dimensions: 24" x 24" and 24" x 18".

Design: Bicycle symbol on square with red circle slash; NO BICYCLES in series C letters on rectangle.

**Curb markings for parking restrictions.** If difficulty is experienced with cars parking in marked bike lanes, the curb may be painted yellow along the length of the lane. Because of the cost of this alternative, it should not be considered a standard procedure.

Lane coloration. Lanes on streets may be marked with colored pavement to distinguish them from the rest of the roadway. If coloration is used, it should not be any of the colors used for warnings or regulations such as yellow or red. This is, however, a costly alternative.

## **Stencilled Pavement Markings**

Stencilled pavement markings may be words or symbols on the pavement for the purpose of guiding, warning or regulating traffic. White is the recommended color for all such pavement markings. All markers should be scaled for the speed of the road upon which the bikeway is placed except on bike paths which may be scaled down for a speed of 12 m.p.h. (7.4 k.p.h.).

Two stencilled pavement markings are recommended for use on bike lanes and bike paths. They are: arrow, and bike only stencils.



Use: channelizes and guides bicycle traffic through areas of uncertainty such as intersections. Indicates direction of travel on one-way bikeways.

Location: place on lane or path 30 feet from area of channelization and uncertainty and at beginning of block, in conjunction with bikes only sign to indicate one-way travel.

**Bikes Only** 

Arrow



Use: identifies bike lane path and restricts motorist and pedestrians.

Location: place at beginning of each block and along the lane or path as needed to clearly delineate the bikeway.

Lane striping. A bicycle lane without a physical barrier shall be marked by a double white solid line (two 4" (.1 m) painted lines with a 4 inch (.1 m) space between). To allow access, the line should be broken at intersections and at points where significant traffic will have to cross such as at alleys and at parking lot entrances.

In intersections where continued channelization is needed a broken white line may be used. (See Figure 15a, b, c.)

The double white line may be carried into the intersection in cases where channelization of a lane through a righthand turn is needed. (See Figure 15c.)

On roads where bike lanes are marked, vehicle lanes and centerlines must also be marked. Confusion occurs when traffic lanes are not also marked.

If there is not enough room to mark all lanes allowing adequate widths, then the road is too narrow and the bikeway should either be changed to a route or moved to another location.

# VI. COLLATERAL FACILITIES

# **Bikeway Lighting**

If considerable night-time usage is anticipated, lighting must be provided to assure safe operation of a bikeway. Adequate lighting is that which allows the bicyclist to see motorists, other bicyclists, obstacles, surfaces, and all safety and directional markings. Motorists and pedestrians must also be able to see the bicyclist.

The best and most economical method of lighting is to position the light source so that all objects can be seen in silhouette (i.e., light from behind).

Some of the considerations to take into account in analyzing the need for a lighting system are: amount of night-time use, night accident record, crime records of surrounding area, bikeway safety hazards (e.g., intersections, sharp curves, obstacles).

The following lighting characteristics should be considered and specified for a bikeway lighting project:

- a) Luminaire mounting height, transverse (overhang) location, and longitudinal spacing.
- b) The overall arrangement of luminaries.
- c) The percentage of lamp light directed toward the pavement and adjacent areas as a function of the characteristics of the bikeway surface and surrounding area (the utilization factor).
- d) The most economical light source to be used, determined by initial and maintained lumen output per watt, length of service, and general lamp costs.
- e) The maintained efficiency of the system.

These minimum standards shall apply for the lighting of bikeways.

#### Route

If special lighting is required other than the standard specifications for the street, the route should be upgraded to a lane or path.

#### Lane or Path

Continuous lighting - 0.6 maintained horizontal foot candles. Rural intersections - 0.2 maintained horizontal foot candles. Urban intersections - 1.0 maintained horizontal foot candles. Major urban intersections - 2.0 maintained horizontal foot candles. Intersections of bikeways - 0.6 maintained horizontal foot candles. Uniformity Ratio - 3:1 average to minimum maintained horizontal foot candles. Consideration should be given to using reflectorized paint for all bikeway crossing markings to improve their night time visibility to motorists.

Because of the danger of vandalism, all lights should be at least 15 feet (4.6 m) high.

Louvers and shields should be considered to minimize glare.

It is important to remember that insufficient lighting may be worse than no lighting at all. It may give the bicyclist a false sense of security without providing enough light for him to be seen by other bicyclists or motorists.

# **Rest Areas**

Rest areas should be provided along heavily used bikeway facilities at 5 to 8 mile intervals in rural areas. Consideration should be made of existing commercial facilities and other available facilities such as local parks. Rest areas should include trash facilities, restrooms, rain shelters, water fountains, bike parking areas, and bikeway information maps.

Rest areas should be located near points of interest or grassy areas where picnic tables may be included.

Small rest stops for bikeways may be included under bridges within the highway right-of-way. These need be no more than a bench and bike parking area so the bicyclist can get out of the rain or away from the sun for a short rest.

Overlooks and points of interest should have a pull off area for bicyclists to use.

#### **Bicycle Parking Areas**

Bike parking facilities should be provided at terminal points of commuter bike routes, rest areas, in parks, and anywhere else bicyclists stop. Bicycle parking facilities should be considered in conjunction with public transit. Bicycles may be used for the trip from home to public transit. They may or may not be built and maintained by the agency that constructs the bikeway.

No specific bicycle parking facility design will be recommended here but the following considerations should be taken into account in the selection of a bicycle parking facility.

- located near destination (the closer the better), but out of the way of pedestrians and traffic.

- protects bicycles from the weather (inside building or parking ramp; separate shelter facility; enclosed bicycle locker).

- supports bicycle by frame, not by wheel (unless hung by wheel off the ground).

- allows the locking of both wheels and frame.

- easily found and signed (unless for commuters on a contract basis).

- provide surveillance for bicycle facilities used by commuters and that are vulnerable to theft (parking ramps may be best).

The lack of adequate bicycle parking facilities is one of the greatest, if not the greatest hindrance, to commuter bicycling.

# **Automobile Parking Facilities**

For off road paths there should be parking facilities for cars at the trail head. Bicyclists can come by car and enjoy bicycling on the bicycle paths.

In urban areas, fringe parking areas may be needed to allow commuters to park their cars a distance from their work and bicycle the rest of the way to their destinations.

# VII. SNOWMOBILE AND OTHER TRAIL USERS WITHIN THE HIGHWAY RIGHT-OF-WAY

Bicycling is the only major trail use which should be accommodated within the highway right-of-way. The other trail uses covered in this section may have some need to use the highway right-of-way, but that need is limited to short trail length joining other sections of trail off the highway right-of-way and safe crossing areas.

Snowmobiling is not encouraged within the highway right-of-way for several reasons. The potential for automobile-snowmobile accidents is great. High snowmobile speeds, and slippery winter highway conditions greatly increase the probability and severity of snowmobile-automobile accidents when snowmobiles operate near highways. The temptation for snowmobilers to operate on the shoulder of the road, instead of in the ditch or on the backslope also increases the potential for accidents.

Snowmobiles cannot be controlled on bare pavement, hard packed snow, or on the icy conditions prevalent on most roadways during the winter months.

At night, snowmobiles operating along the road cause a great hazard for automobiles. Under circumstances of limited visability, snowmobile lights can be mistaken for automobile head lights causing approaching motorists to steer toward the lights and off of the road. The lights of several approaching snowmobiles disturb and disorient motorists increasing the potential for accidents.

Road ditches and shoulders offer a much-needed corridor for snowmobilers, but the hazards in these areas are great. High speeds, poor lighting, and drifted snow, make driveway exits, steel posts and culverts formidable hazards.

In rural as well as suburban areas most housing is adjacent to the roads and highways. Snowmobiles operating in the ditch within the highway right-of-way are led past the front doors of everyone along the road. The noise generated by snowmobiles will likely cause opposition from the home owners adjacent to any highway right-of-way in which a snowmobile trail is designated.

There are ample opportunities for snowmobile trails in areas outside the highway right-of-way. Because snowmobiling takes place during the winter when many areas lay dormant, there are many opportunities that are not available to other trail users. Farm lands are often available, swamps and bogs are frozen and available. These areas should be thoroughly investigated before any thought of the highway right-of-way is given.

Other winter sports such as ski touring and snowshoeing, are not well suited to use within the highway right-of-way. They do not present a real hazard to the motorist but because of the solitary aesthetic elements of these activities, the highway right-of-way is not a desirable place to perform these activities. The intrusion of automobile traffic is distracting. The terrain and gradations restrict the possibilities for a rewarding trail experience. Ski touring and snowshoeing, like snowmobiling, are more appropriately performed in areas outside the highway right-of-way. Horseback riding within the highway right-of-way is often done because of the lack of alternative places to ride. Pedestrian usage of the highway right-of-way is provided for in urban areas by sidewalks. In rural areas, walking is done on the shoulder of the road for lack of a better place to walk.

Sidewalks in urban areas provide an excellent solution to the need. In rural areas, the occasional use of the road shoulder to get from one place to another will continue, but trail development is best done entirely off of the highway right-of-way.

#### Planning and Design of Trails and Trail Systems

Because the trail segments that are within the highway right-of-way are small links in a trail or trail system, it is proper that the segments on the highway right-of-way conform to the design of the total trail. Specific trail design and planning recommendations will not be made here. Listed below are recommended trail manuals for the various kinds of trails.

#### Snowmobiling

Snowmobiling and Ski Touring Trail Manual, Minnesota Department of Natural Resources. Centennial Building, St. Paul, Minnesota 55101.

#### Ski Touring

Ski Touring Trail Planner. Timothy B. Knopp and Jack P. Maloney, Published by the North Star Ski Touring Club of Minnesota, P.O. Box 15059, Commerce Station, Minneapolis, Minnesota 55415.

#### Equestrian

Trails Manual, Charles Vogel. Published by Equestrian Trails, Inc., 10723 Riverside Drive, North Hollywood, California 91602.

#### Hiking

Trail Planning and Layout, Byron L. Asbough. Published by National Audobon Society, 950 Third Avenue, New York, New York 10022.

#### Trail Facilities Within the Highway Right-of-Way

**Trails Along the Roadway.** In most cases, trails along the roadways are not recommended but with proper separation a trail facility may be allowable within the highway right-of-way. In most cases, this type of facility should be a short connector in a trail system where other alternatives are not feasible. New highway construction may appropriately include parallel trail facilities if adequate right-of-way is available. Criteria for the inclusion of these kinds of facilities within the highway right-of-way are shown in Table 7.

Trails are allowed within freeway rights-of-way if a fence is put between the trail and the roadway. Most often adjacent land owners will require that fencing

# TABLE 7 CRITERIA FOR TRAILS ALONG THE ROADWAY

Factors	Snowmobile	Ski Touring	Pedestrian	Equestrian
Type of Highway				
Interstate Freeways	Not allowed within freeway right-of-way	Allowed if fence is placed between trail and roadway	Allowed if fence is placed between trail and roadway	Allowed if fence is placed between trail and roadway
Other Trunk Highways	Allowed in ditch and on backslope	Allowed in ditch and on backslope	Allowed on shoulder of road, in ditch and on backslope	Allowed in ditch and on backslope
Hours of Use	Sunrise to sunset	No restriction	No restriction	No restriction
Speed Limit on Trail	30 mph (19 kph)	None	None	None
Direction of Travel	Inside 30 ft. clear- way one way same direction as nearest lane of highway travel	Either one way or two way as indicated by trail usage	Two way	Either one way or two way as indicated by trail usage
	Outside safe clear- way — same direction as trail usage			
Relation to Dwellings	Permission if within 100 ft. of any residential dwelling			

be placed between the trail and their land. This creates a completely closed-in situation which is neither safe nor aesthetically pleasing.

Snowmobiles are prohibited from the interstate freeway right-of-way by Minnesota Statutes, Section 84.87. Snowmobiles are allowed on other highways in the ditch and on the backslope of the highway right-of-way. The only area that is recommended is the top of the backslope and that is recommended only if there is adequate space available. Ski touring and horseback riding should be confined to that same general area. Figure 13 illustrates desirable locations of highway paths. The same general locations are recommended for all other trail facilities within the highway right-of-way.

If no other alternative is plausible, pedestrian trails may be placed on the roadway shoulder in the same manner as is the bicycle lane (Figures 11, 12, 13). Two-way trail traffic may be allowed.

Snowmobile trails must be one-way in the same direction as the closest vehicle lane traffic if the trail is closer than 30 feet to the road. Trails more than 30 feet from the road may be two-way.

The speed limit on these snowmobile trails will not exceed 30 m.p.h. (19 k.p.h.) and may be less if conditions warrant.

Because of the problems of snowmobile lights distracting motorists, snowmobile trails within the highway right-of-way will not be used from sunset to sunrise except in cases of emergency.

Because of the noise factor, no snowmobile trails within the highway right-of-way will be placed within 100 feet (30 m) of any residential dwelling unless written permission is received from the occupant to allow the placement of that trail. Reaffirmation of that permission must be received yearly.

At-Grade Crossings. Trails will need to cross the roadway and special consideration must be taken to provide for the safety of those who are crossing. Most crossing will be made at grade, that is, where the trail user must cross the highway using the road surface. The potential for conflict between motor vehicle traffic and the trail users is very real. Careful control must be exerted to insure the safety of those crossing. Table 8 shows the criteria for the placement of at-grade crossings on the highway right-of-way.

At-grade crossings will not be made across freeways or other highways where grade-separated crossings are available.

At-grade crossings are recommended to be placed at least 1000 feet (305 m) from any intersection. The crossing should be made perpendicular to the roadway and in an area where there is at least 600 feet (183 m) of sight distance in both directions (see Figure 22). The area where the trail users wait to make their crossing must be outside of the shoulder of the road and allow clear view of the roadway in both directions. If extensive night use is anticipated, a flashing caution light should be placed at the crossing to warn motorists of possible hazard.

If it is not possible or feasible to have the crossing at least 200 feet (61 m) from an intersection, the crossing should be brought in to cross with the intersection. Minnesota Statutes, Section 84.87, states that snowmobiles should

TABLE 8					
CRITERIA FOR TRAILS ON AT-GRADE CROSSINGS					
Factors	Snowmobile	Ski Touring	Pedestrians	Equestrian	
Type of Highway Crossed					
Interstate Freeways	Not allowed (see grade-separated crossings)	Not allowed (see grade-separated crossings)	Not allowed (see grade-separated crossings)	Not allowed (see grade-separated crossings)	
Other Trunk Highways	Allowed	Allowed	Allowed	Allowed	
Location of Trail Crossings					
in relation to intersection	Within 30 ft. (9 m) of intersection across multi-lane highways. 1,000 ft. (305 m) from intersections or within 30 ft. (9 m) of intersections across other highways	Within 30 ft. (9 m) of intersection or more than 1,000 ft. (305 m) from any	Within 30 ft. (9 m) of intersection or more than 1,000 ft. (305 m) from any	Within 30 ft. (9 m) of intersection or more than 1,000 ft. (305 m) from any intersection	
sight distance minimum	600 ft. (183 m)	600 ft. (183 m)	600 ft. (183 m)	600 ft. (183 m)	
Hours of Use	No restriction	No restriction	No restriction	No restriction	

make all crossings of multi-lane roads at intersections. Figure 23 shows an example of a trail crossing at an intersection.



**Grade-Separated Crossings.** Bridges are normally provided to separate traffic at freeways and expressways. Trails which must cross a freeway or expressway can often be routed over or under existing bridges. Table 9 indicates the circumstances under which trail users may use existing highway grade-separated crossings.

Snowmobiles may cross either on highway bridges or through underpasses if trails are provided in the same manner as the bike paths shown in Figure 11d and

# TABLE 9

# CRITERIA FOR GRADE-SEPARATED CROSSINGS

Factors	Snowmobile	Ski Touring	Pedestrians	Equestrian
ADT of highway on bridge or underpass	N/A	N/A	N/A	1000 or less
Sight distance to bridge or underpass	500 ft. minimum (152 m)	500 ft. minimum (152 m)	500 ft. minimum (152 m)	500 ft. minimum (152 m)
Width of road shoulder	N/A	N/A	4 ft. minimum (.6 m)	6 ft. minimum (1.9 m)

13. If a separation between road and trail cannot be provided, the trail may not be placed on the bridge or through the underpass. In these instances, a separate pedestrian bridge type of structure must be provided (Figure 14).

Pedestrian crossings may be made on the shoulder of the road on bridges and on the shoulder of the road through the underpasses.

Equestrian trails may also be placed on the shoulder of the road to cross a bridge or underpass if the ADT of the road is less than 1000 and the shoulder is at least 6 feet (1.9 m) wide. If the ADT is in excess of 1000, serious consideration should be given to providing a separate crossing (Figure 14) or a barrier crossing such as that shown for bicycles in Figures 11d and 13.

Ski touring crossings may be made on the shoulder of the road as a pedestrian movement by removing the skis and walking across. If separate facilities are possible, the ski touring trail may be extended across the bridge or through the underpass in the same general way that bicycle paths cross as shown in Figures 11d and 13.

# Signing

Signing on trails should conform with signing standards developed by the Minnesota Department of Natural Resources. Signing information may be requested from the State Trail Coordinator, 320 Centennial Building, St. Paul, Minnesota 55155.

Sign placement will vary with different terrain. In open areas, such as along the highway right-of-way, signs should be placed no more than 300 feet apart or in a line of sight manner so the rider can see the sign ahead. In cases of possible

confusion in open areas, it might be necessary to use larger directional signs that indicate the distance to be traveled in a straight line. Signs should always be placed on the right side of the trail. They should be between 3 and 6 feet off the trail itself depending on visability. They should never be placed in such a position as to constitute a hazard to the trail users. Signs should be placed at approximate eye level. Stop signs should be used on trails where they cross the highway to assure safe cautious crossings.

Signs warning motorists of trail crossings should be placed on the roadway in the same manner as they are for bikeway crossings.

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# **APPENDIX A**

# **TRAIL FUNDING**

Funding is necessary to the implementation of any trail or trail system. The finding of funds for needed trails is one of the more perplexing problems since there are no easy solutions and taxes are already a heavy burden.

In most cases funding for trails will be a cooperative effort with several sources involved. Federal, State and local government are all active in the funding of trails.

The following is a discussion of existing sources of state and federal funds for trails. Local sources of money will vary with the different local governments, but there are several potential sources within the local government funding structure. Possible new sources of funding will also be mentioned although none will be recommended. Whether any potential new source of money is feasible remains to be seen.

### **Existing Sources of State and Federal Funds**

At the present time there exist a number of sources of funds that may be used for the development and maintenance of trails in Minnesota.

However, in most of these cases trail development is competing with other activities for the use of these funds.

Federal Land and Water Conservation Fund. The LAWCON program is a federally funded program administered by the State government. The objective of this program is to provide financial assistance to the state and its political subdivisions for the acquisition and development of outdoor recreation areas and facilities for the general public. Minnesota's appropriation for the LAWCON program in fiscal year 1975 is approximately \$3.1 million. Half of these funds will be spent by the Minnesota Department of Natural Resources for acquisition and development in state parks. The other half will be allocated to local units of government.

In order to receive funds from the LAWCON program the state has developed an Outdoor Recreation Plan. This plan indicates that trail development is one of the recreational needs that exists in Minnesota. Accordingly, the development of trails is an eligible item for LAWCON funds.

A problem exists in the fact that LAWCON funds are limited and that while trail development is listed as an existing recreational need such development will have to compete with the needs for other recreation activities. Consequently, to rely solely on LAWCON funds for the development of trails would definitely not meet the existing needs.

Minnesota Natural Resource Fund. The Minnesota Natural Resources Fund is a state program that provides funds that can be used in conjunction with federal outdoor recreation oriented grant-in-aid programs, such as the LAWCON program. The existing legislation also provides that funds from this program may be used for outdoor recreation projects where no federal assistance is obtained. Since the Natural Resources Fund is used to supplement the funding of projects receiving LAWCON monies, the type of projects eligible would be the same.

Funds for the Natural Resources Fund are obtained from the cigarette tax. Presently, 11% of the total receipts from the cigarette tax is designated as the Natural Resources Fund. In fiscal year 1973 this amounted to \$8 million which provided funds for a number of recreation and natural resource programs.

As in the case of the LAWCON program, the Natural Resources funds may be used for trails, but the needs for trails must compete with other recreational needs of the state. Thus, only very high priority trails can be developed with these funds.

Minnesota Recreational Trail Program. The one program administered by the State that provides funds solely for the development and maintenance of trails is the State Recreational Trail program. During fiscal year 1974, \$1,007,111 in state funds were appropriated for this program. These funds were used primarily for snowmobile trails. Funds are available for the following types of trail expenditures:

Grant-in-aid for Inspection and Enforcement of Snowmobile Trails

Construction of Snowmobile Trails

Acquisition of Land to Connect Designated Trails

Grant-in-aid for Bicycle Path Acquisition and Construction

These funds are at the present time limited in the areas of bicycle path funding and although consideration has been given to other trail users such as ski touring trails, no grants have been made for that purpose.

**Federal-Aid Highway Funds.** The improvement of highways on the Federal-aid system is a cooperative program between the State highway agency and the Federal Highway Administration. Each year, the Federal government apportions to the States Federal-aid funds for the construction and improvement of roads and bridges on the Federal-aid highway systems.

Facilities for pedestrians and bicyclists can be included in Federal-aid highway projects in two ways. Such facilities can be constructed as incidental features of a project designed to serve motorized traffic. In this case, the incidental facilities must not require additional right-of-way.

Bicycle and pedestrian facilities may also be constructed as independent highway projects with the main objective of providing a travelled way for bicycles and/or pedestrians. Independent projects may be constructed off of the normal Federal-aid highway right-of-way when the facility is to accommodate traffic which would otherwise have used a Federal-aid route. In making the determination whether the bicycle route serves traffic which would have used a particular Federal-aid route, any legal prohibition against bicyclists using the highway right-of-way may be disregarded.

Where bicycle and pedestrian facilities are constructed as incidental features of a highway project, their costs usually are a minor part of the whole and there are no prescribed fund limitations. For independent projects, the amount of Federal-aid highway funds obligated for such facilities in a fiscal year (July 1 to June 30) may not exceed \$2 million per State, or a lesser amount so as not to exceed a total of \$40 million nationwide for all such improvements made under Federally funded programs.

The State highway department initiates the planning, design and construction of all Federal-aid, Interstate, primary and secondary highway projects. Urban projects are cooperatively developed by the local and State officials. As the project route or system may require, the State works directly with county or city officials in the development of project details; in some cases, there is local funding participation. Communities or groups desirous of incorporating bicycle or pedestrian facilities in projects should present their views to the local and State highway agencies and obtain information on procedures to be followed. Since local assistance in the planning and operation of such facilities is needed, it is the function of local officials to make the proposals to the State.

Projects proposed for Federal-aid funding on the urban system are selected by locally elected officials of the jurisdictions involved acting through the metropolitan planning agency designated by the Governor. These projects must have the specific concurrence of the State highway department.

In addition, a share of the State's Federal-aid urban system apportionment is "earmarked" for urbanized areas with a population of 200,000 and over. This "earmarking" of funds provides these communities a greater voice in the urban system project selection in their communities.

Bicycle and pedestrian projects in urbanized areas (communities with a population of 50,000 or more) should be based on a comprehensive transportation plan developed cooperatively by the State and local communities. This planning normally has the assistance of Federal-aid highway funds for this purpose. These funds have been apportioned to the States and are now available to construct bicycle and pedestrian facilities where the State decides that this is the most advantageous use of their limited Federal-aid highway funds.

Requests for funding of specific projects must be submitted in sufficient time to permit the obligation of funds in the fiscal year that the funds are to be obligated by the State. This deadline will be determined by the State highway agencies.

## Local Sources of Trail Funding

Since local governments are creatures of the state, the funding alternatives open to them are more limited than those available to the state.

The alternatives which appear to have the most potential on the local level are: (1) revenue sharing, (2) general obligation bonds, (3) general fund revenue, and (4) County Road and Bridge Funds. Obviously, trails must compete with the myriad of other facilities and services which are needed and demanded by residents of any community.

**Revenue Sharing.** The demand on the limited funds received through revenue sharing far exceeds the funds available. However, both the transportation and recreation implications of trails merit consideration of this potential funding means.

General Obligation Bonds. It is a rather common practice on the local level to use general oblication bonds for the construction of transportation facilities, parks and related capital improvements. Even though the use of bonds for bikeways requires a referendum, such a referendum gives an indication of citizen and voter interest and support. General obligation bonds, therefore, appear to have potential as one local funding alternative.

**General Fund.** Revenue from the general fund can generally be used to provide the necessary facilities and services at the local as well as the state level. One difficulty associated with using the general fund alternative for bikeways development is that the financing of extensive capital facilities from the revenue available in a single fiscal year is frequently impractical if not impossible. Nevertheless, this is one local funding alternative.

**County Road and Bridge Fund.** The Minnesota Legislature passed legislation authorizing the use of County Road and Bridge Funds for bicycle lanes along County highways. This course is most likely to be used in urban counties where the county road and bridge fund is a secondary source of highway money. In rural counties, the county road and bridge fund shoulders the full weight of the county road network. Both construction and maintenance are paid for from this fund. It is unlikely that bike lanes in rural counties will be provided to any large degree from the county road and bridge fund.

# **Potential New Sources of Funding**

Because of the nature of the existing funds available for trail development, it may be necessary to find a new source of funds in order to meet the needs for trails in Minnesota. The competitiveness of the existing programs has resulted in most funds being channelled into recreation and transportation projects other than trail development. The following possible methods of obtaining revenues could be used to make new funds available for the specific purpose of developing trails:

**Excise Tax.** A possible source of new revenue that could supply funds for the development of trails is an increase in certain existing excise taxes or the imposition of an excise tax on certain presently untaxed items. There are three ways revenues for trail development can be obtained through an excise tax: (1) increase the tax rate on certain currently taxed items that produce large amounts of revenue, (2) impose a new tax on selected untaxed items that have the potential of producing large amounts of revenue, (3) impose a tax on trail user items and equipment.

At the present time certain selected excise taxes produce a substantial amount of revenue for the state. For example, the cigarette tax produces nearly \$70 million, the tobacco products tax \$2 million, and the liquor and beer taxes nearly \$45 million. By increasing these taxes slightly a significant amount of new revenue could be raised. These new funds could be directed, at least in part, to the development of trails.

Another way the excise tax could be used to produce new money would be to impose a tax on certain presently nontaxed items. Some potentially taxable items that would produce relatively large amounts of revenue are: soft drinks; tires; inner tubes and tread rubber; radio and television sets; and electric, gas, and oil appliances.

The third type of excise tax that could possibly be used to supply funds for the development of trails would be the imposition of an excise tax on trail user items such as bicycles and ski touring equipment. These types of taxes would provide the state with up to \$1 million that could be used in conjunction with federal funds for trail development.

Two very important factors that must be taken into consideration of the acceptability of an excise tax is the degree of difficulty in administering the tax and the cost of compliance relative to revenues. Factors which affect the efficiency and ease of administration are: (1) number of tax paying units, and (2) the ability to make clear taxable and nontaxable items. In general, the larger the number of taxpayers, the more difficult the problem of administration and the greater the cost of compliance.

In the case of an excise tax on trail users equipment the tax would be both difficult to administer and the cost of compliance would be high. With the exception of the sale of snowmobiles and snowmobile equipment, trail user equipment is sold by a very large number of dealers. Many of these dealers are small businesses which makes compliance and administration very difficult. Because the items which would be classified as trail user equipment is difficult to define, compliance with the excise tax law would be difficult to enforce.

Similar problems would exist in the imposition of an excise tax on other presently untaxed items. Consequently, it appears that the most attractive use of the excise tax to obtain new revenue would be to increase existing taxes. Of the existing excise taxes, the one that would be the easiest to increase to obtain funds for trail development is the cigarette tax.

At present, Minnesota had designated part of the State Cigarette Tax as a Natural Resources Fund (see described under Present Funding). It is presently being used in part for trail development. The Department of Natural Resources is using these funds for recreational trail corridors and State Planning Agency is using some Natural Resources Funds to match local recreational trails development funds.

1973 income from the cigarette tax was over \$70 million. Of this amount, 11% (\$8 million) was credited to the Natural Resources Fund.

Trail development could be funded from the cigarette tax by either increasing the amount of the Natural Resources Fund and designating part of it for trails, or by creating a separate fund to be used for trail development.
User Charges. Another source of potential revenue which could be used to provide funds for the trails is the collection of fees from individuals using existing trail facilities. The actual income that could be collected from such fees at this point is difficult to determine. Revenue from this source would depend on the number of facilities charging fees and the types and amount of fees charged. Some typical user charges that could be instituted would be a charge on a daily basis, per vehicle using a trail, or a yearly permit for the vehicle which would allow usage of all state trails (similar to the State Park Permit). Because some trails could be used by different types of vehicles an alternative would be to issue the permit to the individual rather than the vehicle.

Two shortcomings of such a users fee is the cost of administration or enforcement and the effect of such fees in discouraging the use of the trails. In order to obtain revenue beyond the cost of administering a permit system it may be necessary to charge a fee which would discourage the use of the trails. The single major disadvantage of these charges is their regressive character. Charges typically mean low-income persons would not be able to use the facilities because of the charge.

While fees and charges may not be a good source of revenue for trail development, it may be an attractive source of funds to be used for regulation and maintenance of existing trails. In establishing fees or charges it is important to remember that, generally speaking, fees should at least cover the clerical, inspection and enforcement cost associated with their imposition.

**Registration.** A third source of funds that could be considered for trail purposes is the statewide registration of trail user vehicles such as bicycles. As in the case of the users charges, the high cost of administering such a registration program may also be used as a method of enforcing safety standards, if such a program were developed in Minnesota.

The most obvious problem with the establishment of a statewide registration system is the cost of developing such a system and the cost of administering the program once established. It is estimated that a registration fee of approximately \$2.50 for each new bicycle would have to be charged in order to pay for just the administration cost of the program. Thus, in order to obtain funds that could be used for development or maintenance of trails an amount in excess of \$2.50 would have to be charged.

**Gasoline Tax.** Gasoline tax is presently being used in part for snowmobile and bicycle trail development. The Department of Natural Resources receives 3/8 of 1% of the state gas tax. This is considered to be the amount of the tax on gas which is used by snowmobilers and is therefore refundable, but which has not been claimed for refund.

The use of the Highway Department's portion of the gasoline tax revenues for bikeway and trail development is subject to controversy. Under existing conditions, the use of the gasoline tax for purposes other than street and highway improvements is constitutionally prohibited.

Those who oppose the use of the gasoline tax for other purposes argue that the Highway Trust Fund was generated by the consumption of gasoline and other motor fuels and, therefore, it should be only tapped to provide for the streets and highways necessary for motor vehicle travel. The fear is expressed that once the Trust Fund is opened to other users, it will no longer meet the needs for highways and street improvements. These opponents to the use of the gasoline tax also indicate that the trust funds are inadequate to meet the current needs — much less to construct bikeways.

Proponents who favor the use of gasoline tax revenues for bikeway development counter with the argument that the tax is basically a transportation tax and should be used for all forms of transportation. They point out that the construction and use of transportation modes other than the private automobile will tend to alleviate some of the traffic congestion, reduce air pollution, negate the need for additional expensive parking facilities, put to a better use the valuable urban land, and increase the quality of urban living. Proponents for use of the tax also emphasize that street improvements and freeways generate additional traffic which *increases* not *decreases* traffic congestion. In addition, they voice the view that people need a choice of transportation and that as long as the gasoline tax is easily collected and used exclusively for only motor vehicle travel, people will have little freedom of transportation choice.

Other states have already made the decision to use the gasoline tax for bikeways. The most heralded example is Oregon which allocates one percent of the gas tax specifically for bikeway construction. Maryland, New York and California also use the gasoline tax for bikeways.

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