THE POTENTIAL FOR USING FIRE ROADS AS BICYCLE TRAILS IN KOOTENAY NATIONAL PARK

Submitted by: G. MacRae

For : W.R. 271

Date : April/79.

SUMMARY

A representative 100 cyclists were interviewed in Kootenay National Park, to determine whether or not there is a need for bicycle trails within the Park. The data from the 100 questionnaires obtained was analyzed, and yielded enlightening results. Approximately half of the cyclist-visitors originate from the nearby urban metropolis, Calgary. Three-quarters of the people interviewed stated that they would cycle on a trail in the Park, if they were aware of the possibility.

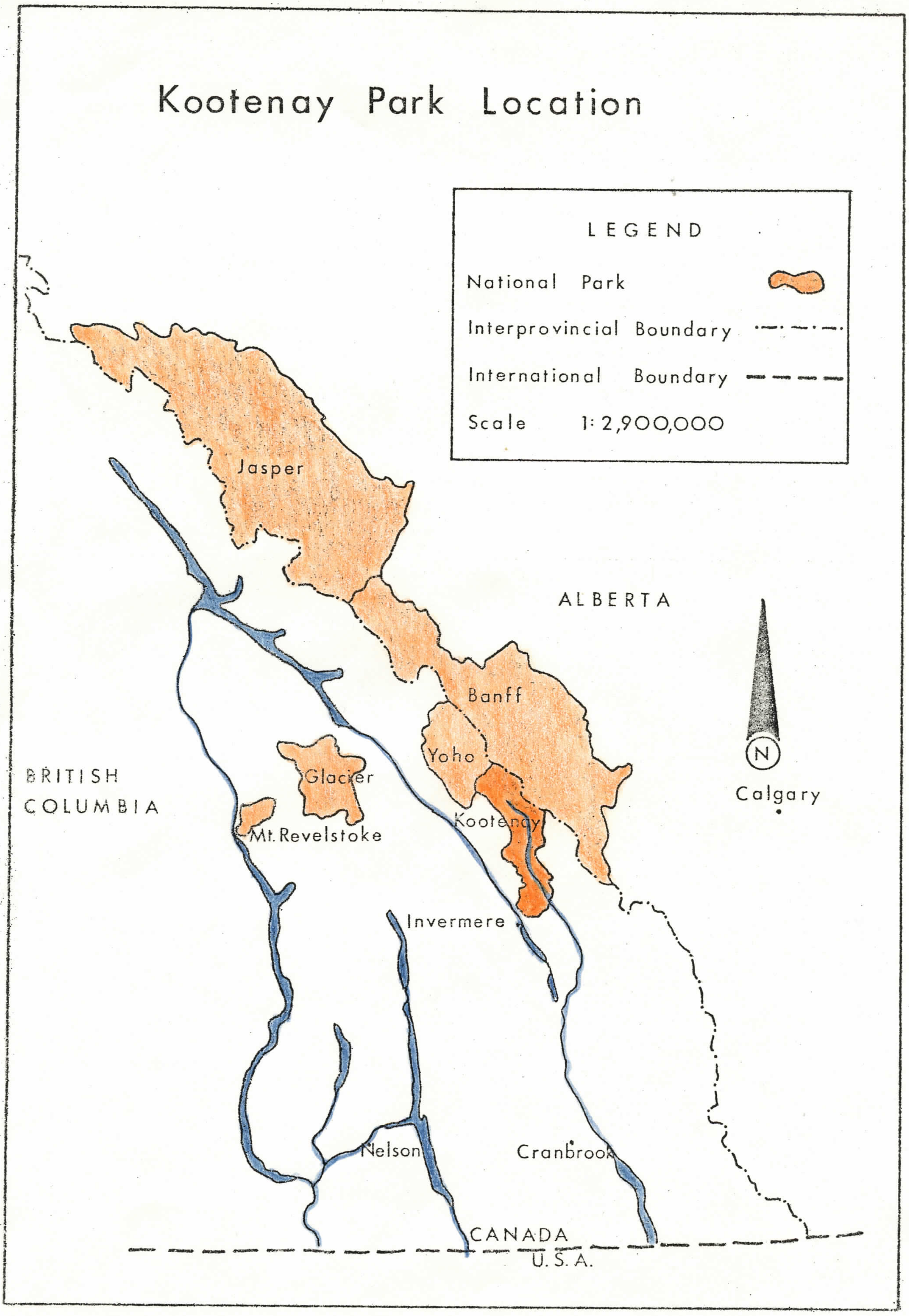
Bicycle paths should be developed using existing fire access roads and the public informed of these cycle routes. These paths should be developed within visitor service guidelines and objectives, and should also take into consideration environmental constraints.

Daisy, Daisy, give me your answer, do;
I'm half crazy, all for the love of you;
It won't be a stylish marriage,
I can't afford a carriage;
But you'll look sweet,
Upon the seat of a bicycle built for two.

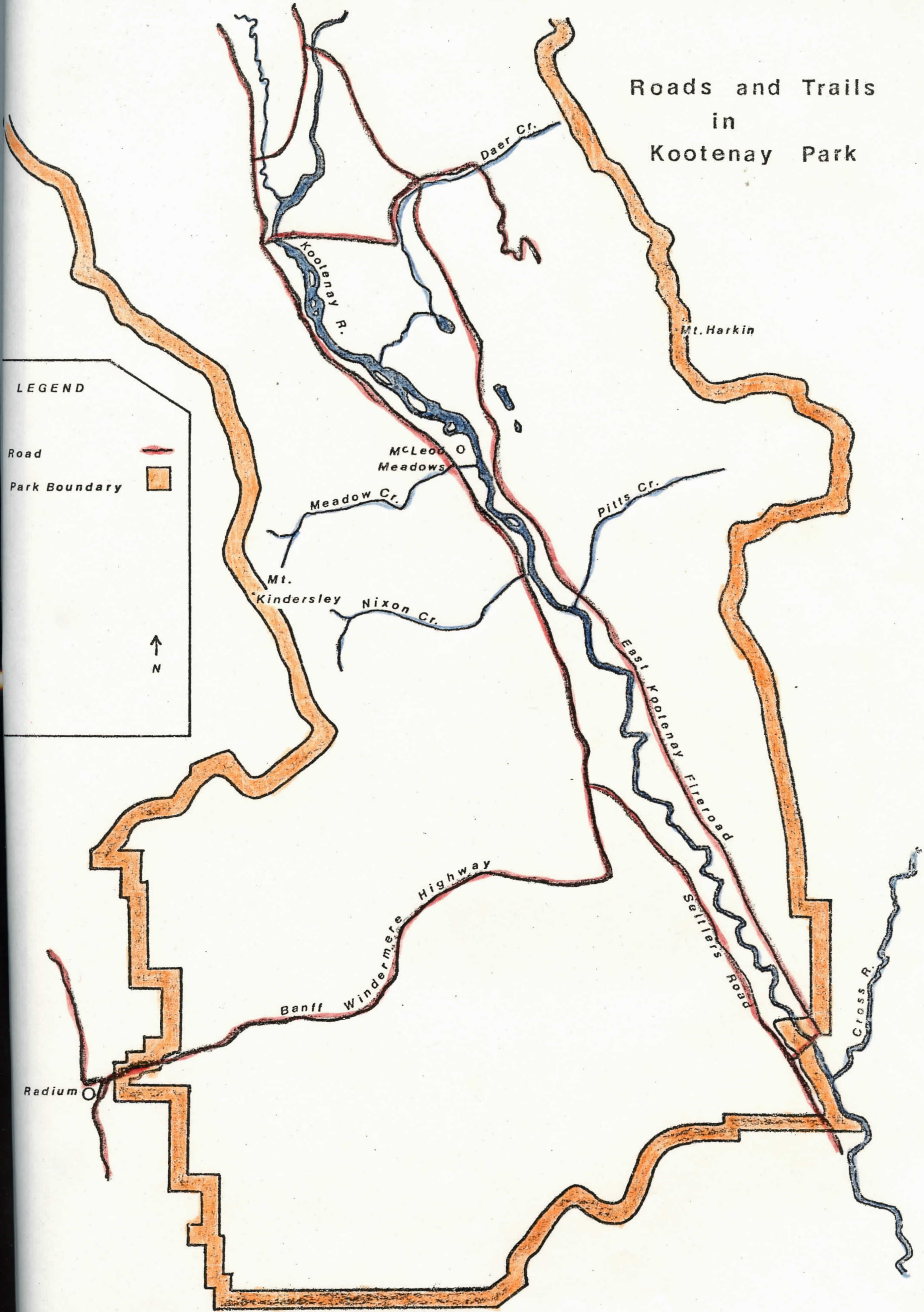
...Traditional

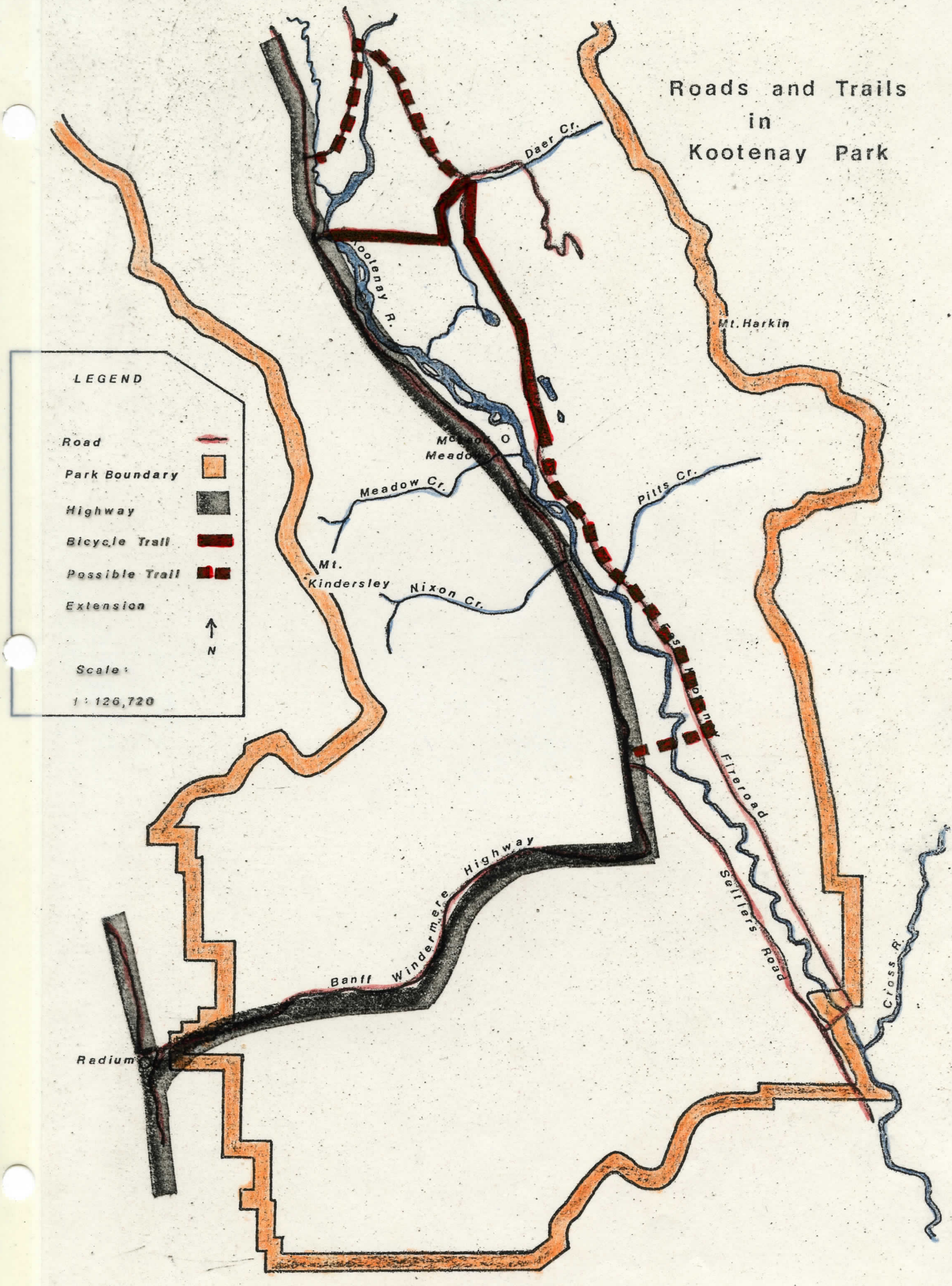
TABLE OF CONTENTS

LIST OF MAPS, TABLES, FIGURES AND PHOTOS


Kootenay Park Location
LEGEND
National Park
Interprovincial Boundary
International Boundary
Scale 1: 2,900,000
Jasper
ALBERTA
Banff
Yoho
Glacier
BRITISH COLUMBIA
Mt. Revelstoke
Kootenay
Calgary
N
Invermere
Nelson
Cranbrook
CANADA
U.S.A.

MAP 1


Roads and Trails
in
Kootenay Park
LEGEND
Road
Park Boundary
N
Daer Cr.
Kootenay R.
Mt. Harkin
McLeod Meadows
Meadow Cr.
Pitts Cr.
Mt. Kindersley
Nixon Cr.
East Kootenay Fireroad
Banff Windermere Highway
Settlers Road
Cross R.
Radium


Roads and Trails
in
Kootenay Park
LEGEND
Road
Park Boundary
Highway
Bicycle Trail
Possible Trail
Extension
N
Scale:
1 : 126,720
Daer Cr.
Kootenay R.
Mt. Harkin
Meadow Cr.
Pitts Cr.
Mt.
Kindersley
Nixon Cr.
Fireroad
Settlers Road
Banff Windermere Highway
Radium
Cross R.

Map 2

THE POTENTIAL FOR USING FIRE ROADS AS BICYCLE TRAILS IN KOOTENAY NATIONAL PARK

I. INTRODUCTION

In recent years, bicycling for fun and recreation has increased tremendously. In response to the needs of these recreationists, many parks in the U.S.A. and Canada, notably Ontario Provincial Parks, have created cycle trails and facilities within their existing systems.

There are no cycle trails or facilities in the Mountain National Parks at this time. This report was undertaken to determine whether or not there is a need for bicycle trails within Kootenay National Park, the present level of cyclist use, and the level of facility and trail development desired by the user.

I have briefly discussed the history of cycling, the recent growth of cycling, and the inherent values of cycling.

A survey of bicycle recreationists was carried out at McLeod Meadows Campground, in Kootenay National Park. The survey technique employed was of the personal interview variety. A copy of the questionnaire used appears in the Appendix (A). The survey results, after analysis, indicate a positive response from cyclists towards trail development.

II. CONCLUSIONS

These conclusions, abstracted from the "Data Interpretation" section are basically a summarization of those interpretations.

To begin with, a majority of the people interviewed were paying return visits to the Park. Secondly, there are a large number of Calgarians visiting the Park of whom about half are travelling primarily by motor vehicle, with bicycles along, and used as leisure transportaion. The other half are cyclists travelling totally by bicycle.

Today's average vacationer has more time than the traditional two-week holiday. This means that most people have more leisure time at their disposal, and therfore, more time for such leisurely activities as cycling, even to the extent of travelling only by bicycle during an entire vacation.

Most of the people surveyed at McLeod Meadows Campground would use a bicycle trail along the proposed route, if they were aware of the possibility. The majority of these people would like to see at least one of the suggested recreation options (picnic tables, campsites, nature rides) along such a trail.

III. RECOMMENDATIONS

These recommendations are based on the results of the cyclist survey. Costs will vary according to the degrees of development and the types of facilities provided. Some cost estimates and trail development standards are included in Appendix B. Recommendations to be considered must, of course, agree with National Park and Visitor Services objectives, and evaluate environmental constraints.

A. Making the trail known to recreationists.

I recommend that:

1. campground attendants be instructed to mention the bicycle route to people with bicycles and to those who inquire.
2. bicycle route marking signs be placed along the trail from the campground to the trail head and at the beginning of the opposite end, where it meets the highway.
3. an indication of the bicycle route be included in the existing map of the campground area; the extent of trail developments and facilities should also be indicated.
4. the ocasional Naturalist Program have a bicycling theme. (The program could inform the audience of the cycle trail and points of interest along the way.)

B. Trail improvements and developments

I recommend that:

1. the first trail development should be to sign the trail, indicating its beginning to people using the campground, and indicating the beginning of the opposite end, where it meets the highway.
2. naturalist-guided nature rides be combined with existing naturalist programs.
3. campsites for cyclists along the bicycle trail be constructed.
4. existing fire access roads be studied for bicycle trails, rather than creating entirely new paths (These roads are not used extensively by vehicles, therefore it is economically and ecologically sound to utilize them, whenever possible); present bicycle trails be extended if it is possible.

IV. HISTORY OF CYCLING

The first "bicycle boom" occured during the 1890's in Europe and North America. It was touched off by two important factors. The first was the invention of the "safety" bicycle in England, essentially very similar to today's modern two-wheeler. The second was the development of assembly line production which made this vehicle available to the general public at an affordable price (around $20 at the time). Incidentally, the inventor of the assembly line, Henry Ford, began his career as a bicycle repairman! This boom was known as the "bike-craze" of the Gay Nineties, which brought about a revolution in the consciousness, status and apparel of women of the era. It enhanced automobile developments and refinements and pioneered improved road surfacing. It is ironic that the pioneering of cyclists to improve roads literally "paved the way" for the automobile. In a relatively short time, the automobile became the vogue and the transportation vehicle for the adult population. The bicycle was relegated to the back seat and considered a suitable toy for children.

V. THE NEW GROWTH OF CYCLING

The phenomenal growth of cycling in the 1960's and 70's can be attributed to several changes in consciousness concerning environmental pollution (especially by the automobile), physical fitness and transportation. It can also be connected, in part, to the development of the modern multi-geared bicycle, popular with cyclists of all ages. The present resurgence of bicycles has been termed "boom" and "explosion". These terms are, however, misleading since bicycle sales have exceeded 6.8 million each year since 1968 and have exceeded automobile sales since 1972. If bicycling were a passing "rage", this sales pattern would not be expected to extend over such a long term. (See Table 1; note: these are U.S. figures)

"Cycling through Kootenay Park--a great way to holiday."

Bicycle-Automobile Sales Comparison (U.S.)

Year	Bicycle Sales (millions)	Auto Sales (millions)
1960	3.7	-
1965	5.6	-
1968	7.5	10.0
1969	7.1	9.7
1970	6.9	8.1
1971	8.9	10.7
1972	13.7	11.0
1973	15.3	11.4

Table 1 (from 14,11)*

* The citation system used in this report is such that the first number in brackets corresponds to the number in the Bibliography and the second number is the page number.

VI. CYCLING VALUES

Changes in attitudes have resulted in rethinking and redefining the worth of the bicycle as it relates to the following values:

A. Recreation

More people ride bicycles for fun, relaxation and enjoyment than for any other reasons. There are many forms of group riding activities such as bicycle camping and touring. Youth Hostels, and bicycle clubs and organizations offer various other group cyclist activities. Competitive races and distance marathons are examples of individual rider recreation.

B. Health and Fitness

The benefits to the body and mind gained through cycling cannot be overestimated. Bicycling tones leg muscles, tones the diaphram, aids digestion and helps in weight control. It is an excellent excercise to improve the condition of the entire cardio-vascular system. Cycling reduces high blood pressure and the incidence of diabetes and coronary thrombosis. In these respects, bicycling probably enhances longevity, according to the late Dr. Paul Dudley White, physician to U.S. President Dwight Eisenhower. (14,9)

In the modern world, society and its cities are sometimes referred to as "the rat race". Compared to most other methods of transportation, the bicycle offers an opportunity to slow down the pace and relax the mind while travelling.

The rider-contact with the environment and the quietness of the machine enable cyclists to hear, see and smell animals, birds and vegetation which the motorist, travelling at high speeds in an enclosed capsule, is completely oblivious to. In this way, cycling slows down the mind and opens up the sences, which can be considered a benefit to the mental health of participants. Changes in Canadian consciousness towards becoming a healthier society has contributed to cycling popularity.

"The slow pace allows time for relaxation and contemplation".

C. Transportation

Dedicated cyclists, youths and paperboys have been using bicycles as transportation vehicles for years. Bicycles have long been used for transportation in Asia and Europe (in the Netherlands, 76% of the nation's people are cyclists). As gas prices continue to rise, people are becoming more aware of automobile costs and its pollution of the environment. As a result, the bicycle is being utilized as transportation in urban job commuting, grocery shopping, bicycle touring and camping. Another asset of bicycling as transportation is the simplicity and inexpense of maintenance and repair. Anyone can accomplish routine maintenance and most repair tasks, with a minimum of instruction and a few basic tools.

Given these trends, it seems possible to project cycling growths and interests into Canada's National Parks. What this means is that cyclists should be considered when planning and designing parks and perhaps, new facilities may be desired to accomodate cyclists in existing parks. There are several Provincial Parks in Ontairo that have constructed bikeways, notably Wasaga Beach Provincial Park, Bronte Creek Provincial Park and the National Capital Commision. Bronte Creek Provincial Park also has a bike rental concession.

VII. THE CASE FOR THE CYCLIST IN KOOTENAY NATIONAL PARK: THE SURVEY OF 1978

A. Objectives of the Survey

The major objective of the survey was to determine whether or not there was a need for a bicycle trail within Kootenay National Park. Whether or not such a trail, if available, would be used by cyclists was a secondary objective. The cyclist survey also determined what types of recreation options would be desired along such a trail. Other information obtained from the survey concerned the visitor. Such details as visitor origin, age, sex, their length of stay, length of vacation and number of previous visits to the Park were ascertained.

B. Survey Method Selected

The questionnaire procedure selected for the survey was a personal interview approach. This method insures all forms will be returned and none will be spoiled. The questionnaire was designed by me, with technical assistance from Rod Loftus, Wildland Recreation Program instructor. It consists of nine questions and an accompanying location map (see Appendix A).

There are two basic assumptions to keep in mind when reading this report. The first is that people will actually do what they say they will do when answering the questionnaire. The second is that the people questioned are a representative sample of the cycling public.

B.(i). The Survey:

The survey was administered by me during my days off over the summer. This was mainly Monday and Tuesday during July and August. The survey was conducted mainly at McLeod Meadows Campground, due to the ideal location adjacent to the East Kootenay Fire Road. The Fire Road was pointed out on a map to each person surveyed as a hypothetical bicycle trail, but it was also chosen because of the potential for an actual cycle trail.

B.(ii). The Location:

The campground is situated in the middle of the Park and consists of 100 campsites, arranged in ten circular areas. Each area has its central wood supply, water supply and washroom facility. The campsites are not fully serviced, in that they do not have running water, sewage disposal or electricity. This is worth noting, due to the fact that cyclists prefer campsites with minimal services, sometimes referred to as "primitive" sites. (For specific location please refer to Map #2, page vi)

C. Sampling Methodology

Basically, the sampling method was a very simple procedure. On my days off, usually every Monday and Tuesday, I would cruise the entire campground several times, but generally between mealtime in the evening and the commencement of the Naturalist Program. Whenever I sighted a vehicle or a campsite with bicycles on or near it, I would approach the campers and politely ask if they would mind taking a few moments to fill out a questionnaire with me. I found people to be very cooperative and friendly. I then explained (by use of a small map) where the East Kootenay Fire Road was in relation to the campground, and proceeded with the questionnaire. Whenever I encountered cyclists at other locations besides McLeod Meadows Campground, I went through the same procedure. Basically, I adhered closely to the printed questions and did not vary my "interrogation" procedure, in order to avoid getting different responses due to re-wording of questions.

"The surveyor and the cyclist"

C.(i). Problems

There were only two minor problems, which manifested themselves immediately. The first was a problem with trail recreation options (i.e. picnic sites, campsites and nature rides). I had expected people to put 'X's' on the maps where they felt picnic tables, campsites etc., should be located (Question #9 on the form; Appendix B)! The initial reaction of most people was, "I don't have a clue, I'd have to see the actual trail,"I couldn't possibly locate anything as detailed as a campsite on this little map!" They were, of course, absolutely correct, so I quickly discarded that idea.

The second problem was that I felt I had omitted an important piece of data which should have been included on the survey form. That information was simply to record the type of transportation the surveyee was using. That is, was he using a bicycle exclusively or was the bicycle a secondary method, brought along on a vehicle? To solve the problem, I simply recorded the type of transportation used on the top of each form. In a systematic fashion of asking nine standard questions to cyclists, just over one hundred forms were completed.

D. Findings

Before the information from 100 survey forms could even begin to be understood, it had to be organized into an easier to interpret format. To accomplish this feat, I.B.M. Fortran Coding Forms were used. These forms are designed for computer use (although computers were not used in handling this data) and therefore all answers must be simplified into numbers. This is somewhat easier than it sounds, for example, a "NO" answer might be a zero figure on the Fortran Form and a "YES" may be a one. It becomes more difficult with such questions as "Where is your home?" It is however, very helpful in determining the total number of like responses to a particular question. The actual Fortran Forms used, and tabulation of final numbers of responses to each question, can be referred to in Appendix C.

E. Data Interpretation

For this section, each question will be approached separately and discussed at length according to its relative importance.

Question #1. "Is this your first visit to Kootenay National Park?"

and

Question #2. "If "no" how many times have you visited previously?"

These are significant questions, because the results determined that there was a large percentage of campers (61%) who were paying return visits to the Park. Equally significant is the knowledge that more than half of these campers (64%) had visited at least once previously, and some had been between five and twenty times! The next question revealed where these people were coming from.

Question #3. "Where is your home?"

The results from this question made it quite evident that the main origin of campers was also the nearest major urban center. It showed that 48% of the people interviewed were journeying from Calgary. Of that number, the majority (26%) were cyclists journeying from Calgary to Invermere and area. The occasional organized group of cyclists journeyed through the parkway. One of these groups, consisting of twenty-one cyclists, was encountered and interviewed. This information illustrates how many people find it relatively easy and enjoyable to undertake a cycle trip of some distance (515 kilometers roundtrip, approximately). This was also expected to be accomplished in a short, five day time span. Such cycle holiday trips may prove to be an increasing trend in the future. (Please refer to Figure 1 for a map of visitor origins.)

Question #4. "What is your destination: a) Today?
b) Total journey?

The "destination today" portion of this question may not be particularly relevant because people were usually asked this question in the evening, when it was fairly obvious


ORIGIN OF CYCLISTS
VISITING KOOTENAY PARK
Rest of
Canada
24%
Rest of
B.C. 7%
Calgary
48%
U.S.
21%

FIG. 1

they weren't going any farther than McLeod Meadows Campground. This is exactly what 68% of the responses to the question were; destination--Kootenay National Park.

However, under "destination for the total journey" section, the responses take on more importance. 12% of the campers were travelling to Kootenay Park, specifically. The largest percentage, 30%, were destined for the Radium, Invermere, Fairmont area. This could be expected, due to the well known fact that many Calgarians have summer residences there. People journeying to Alberta comprised 25% and those visiting other B.C. areas made up 24%. These were the main destination zones.

"Cyclist approaching the Park Boundary"

Question #5. "How long (in days) will your:

a) stay in the Park be?"

b) total journey be?"

It is always interesting to know how long the visitor is remaining within the Park, because it aids in deciding what facilities to plan for, for the majority of guests. By far, the most popular visit duration was two days (63% of visitors), with only a very small percentage (3%) staying longer than three days.

The second part of the question revealed a most informative set of statistics. It showed that 48% of the visitors were vacationing from one to fourteen days and 52% were vacationing for a period of fourteen to thirty days! (or more in a few cases) What this means is that the larger percentage of people have more leisure time than the traditional two-week holiday. More leisure time means that these people can spend more time seeking and experiencing leisure activities, and bicycling is an activity which is gaining in popularity. Certainly, extended leisure time is part of the reason.

Question #6. "Age and Sex of Cyclist(s)."

The number of males cycling outnumbered the females 2.7 to 1. The reason for this is unknown. However, the largest age group for both sexes was the 11-21 year range.

Question #7. "Would you use this trail?"

After describing the present condition of the East Kootenay Fire Road, this question was asked. An amazing 83% of the cyclists interviewed stated that they would use the trail in its present state, and that no improvements were necessary. The main reason that these people were not already using the road is simply that they were unaware of its existence or unaware that cyclists as well as pedestrians could use it. Two fishermen were contacted, who stated that they had been cycling the road for the previous two summers, to obtain quick and easy access to a favorite angling area! This is of particular interest since more campers might bicycle the road, if they were informed of the possibility.

Question #8. "Would you be more inclined to use the trail if it were hard surfaced?"

This question was designed to ascertain whether more people would use, for example, an ashphalt trail than simply the existing gravel road. Indeed, it was expected that most people would prefer a paved trail. The final data was rather surprising, in that the percentage of people who would be more inclined to use a hard surfaced trail was only 74%. However, these two questions provide positive evidence that the majority of cyclists interviewed would use such a bicycle trail, if it were made known to them. (Refer to Figure #2, page:21)

Question #9. "What recreation options (if any) would you like to see along the trail?"

Choices: a) picnic sites; b) campsites; c) self-guided nature walks; d) other

This was the final question asked, and although there is no space on the form for "no options", if that was the choice,

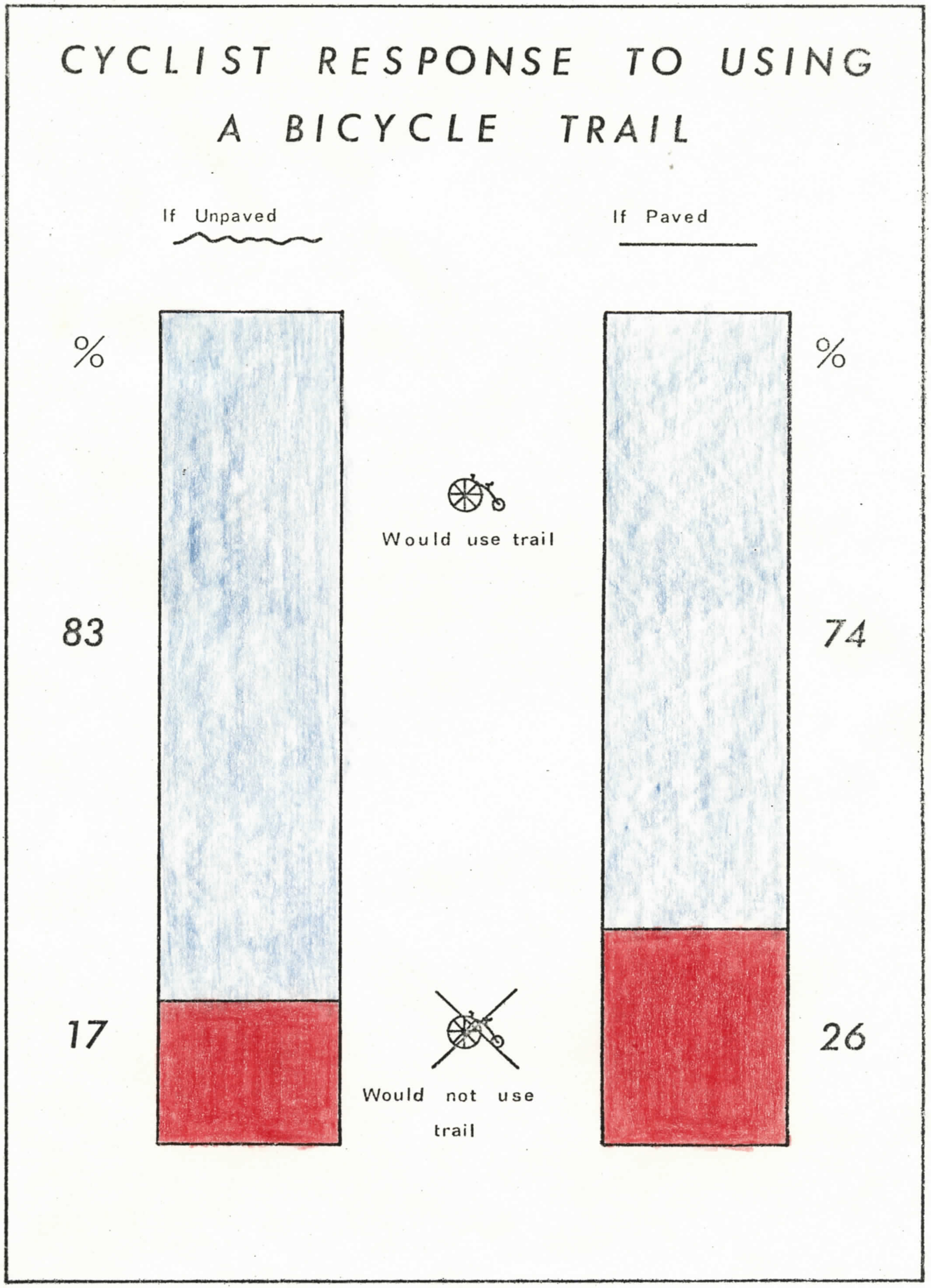

CYCLIST RESPONSE TO USING A BICYCLE TRAIL
If Unpaved
If Paved
%
%
Would use trail
83
74
17
26
Would not use trail

FIG. 2

it was recorded. Also, "nature walks" was explained as "nature rides". Basically, the data can be interpreted in a simplified manner. There was a majority of people (71%) who wanted at least one recreation option along the proposed trail. Only 29% of the visitors questioned wanted no options of any kind along the trail. For a graphic view of the results, please refer to Figure 3. page 23.

"Cycle touring and camping. Do these people want trails?"

A final piece of information tabulated, which again supplies surprising results, was the percentage of cyclists travelling exclusively by bicycle (no motorized method used) which was 49%, compared to 51% of people who brought bicycles along on their motor vehicle, and used them as secondary transportation.

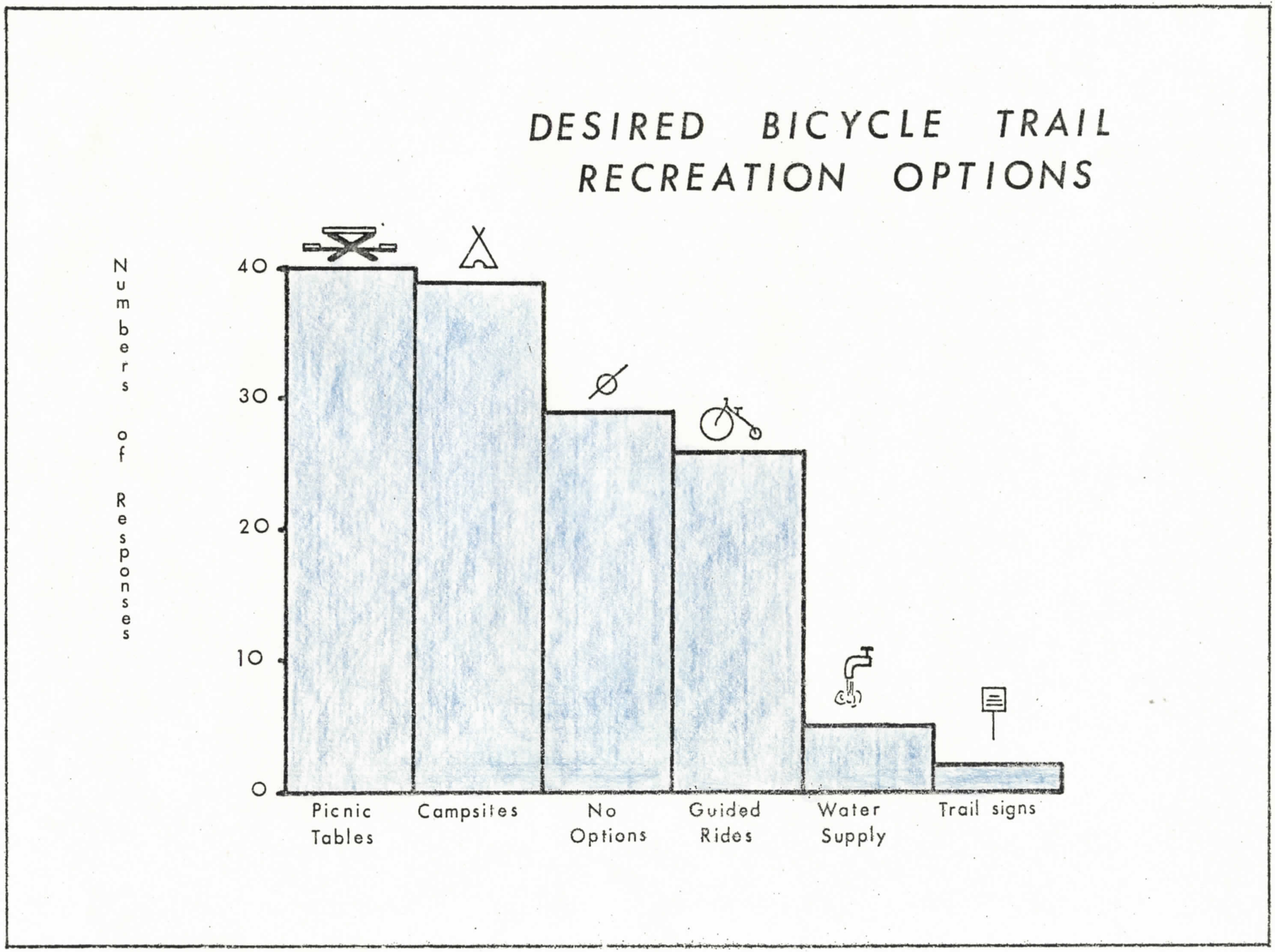

DESIRED BICYCLE TRAIL
RECREATION OPTIONS
Numbers of Responses
40
30
20
10
0
Picnic Tables
Campsites
No Options
Guided Rides
Water Supply
Trail signs

FIG. 3

"Secondary transportaion"

VIII. ESTIMATED NUMBER OF CYCLISTS

From the data gathered during the summer, when the survey was administered, there are some rough inferences which can be made. (Refer to Appendix D for statistical analysis) Basically, the figures can be summarized to arrive at these conclusions:

1) The average number of cyclists (with and without motor vehicles) per month is about 176 people.
2) The possible number of cyclists over a six month period (May, June, July, August, September and October) would be about 1082 $\pm$ 405.

These refer to those cyclists who stop over in the Park, therefore the numbers might change (probably increase) if the people who pass through were also counted. It would be helpful to obtain a more accurate count of cyclists using the Park.

"Cyclists and bicycles come in all sizes and shapes."

IX. BIBLIOGRAPHY

1. Babcock, G.N., Park Superintendant, Wasaga Beach Provincial Park (Ontario). Letter to the author, Nov. 28, 1978.

2. Beck, Leslie and Bill Robinson. Trail Systems. Compiled by Calgary Parks/Recreation Department, Outdoor Recreation, August 1975.

3. Bicycle Paths and Trails. Manual published by Parks Canada, n.d.

4. Bikeways for the Victoria Metropolitan Area. Published by Capital Regional District Planning Dept., P.O. Drawer 1000, Victoria, B.C.,n.d.

5. Bridge, Raymond. Freewheeling: The Bicycle Camping Book. Harrisburg, Pa.: Stackpole Books, 1974.

6. Cleroux, R.J. Parks Supervisor, Cambridge District (Oakville, Ontario). Letter to the author, January 24, 1979.

7. Cuthbertson, Tom. Bike Tripping. Ten Speed Press, Berkely California, 1974.

8. Footpaths and Bike Routes, Guideline. (March/April 1972) Vol. 2, No. 2.

9. Guidelines for Bikeways, Guideline. (September/October 1973) Vol. 3, No. 5.

10. Guidelines for Developing Rural Bike Routes. Wisconsin Dept. of Natural Resources,(March 1975).

11. Hamill, James P. Planning and Development of Bicycle Systems. International City Management Association, Washington, D.C., 1973.

12. Hart, Krinasty, Stubee. B.A.R.T. Trails. Dept. of Transport, Washington, U.S. 1974.

13. Hooper, Lennon W. Pedestrian/Bicycle Planning and Design. Report to Director, Denver Service Center, National Park Service, Denver, Colorado. (February 1, 1973).

14. Jarrell, Temple R. Bikeways, Design-Construction-Programs. Virginia: National Recreation and Park Ass'n., 1974.

15. Planning and Development of Bikeway Systems. International City Management Assoc., Management Information Service. (April 1973) Vol. 5, No. 4.

16. Ross, Tom L., Parks Supervisor, Cambridge District (Oakville, Ontario). Letter to the author, November 28, 1978.

17. Sloane, Eugene A. The New Complete Book of Bicycling. Simon and Shuster, New York, 1974.

18. Smith, Ken, ed. The Canadian Bicycle Book. Toronto: D.C. Health Canada Ltd., 1972.

19. Wilson, Janet. Exploring by Bicycle. Grundy and Bernies Guide Books, Vancouver, 1973.

APPENDIX A

DATE:________________ #________

BICYCLE USER QUESTIONNAIRE

1. Is this your first visit to Kootenay National Park? Yes____ No____

2. If "no" how many times have you visited previously? ____________

3. Where is your home? ____________________________

4. What is your destination: a) Today? ____________________
   b) Total Journey?____________________

5. How long (in days) will your:
   a) stay in Kootenay Park be?____________________
   b) Total journey be?____________________

6. Age and Sex of cyclist(s):

Age in Years

Sex	0-10	11-21	22-31	32-41	42-51	52-61	62-71	72-81	82-100
F									
M									

Here is a map showing a possible bicycle trail from this campgraound, along the West Kootenay Fire Road for 6 miles, (12 return) following the Kootenay River.

7. Woudl you use such a trail? Yes______ No______

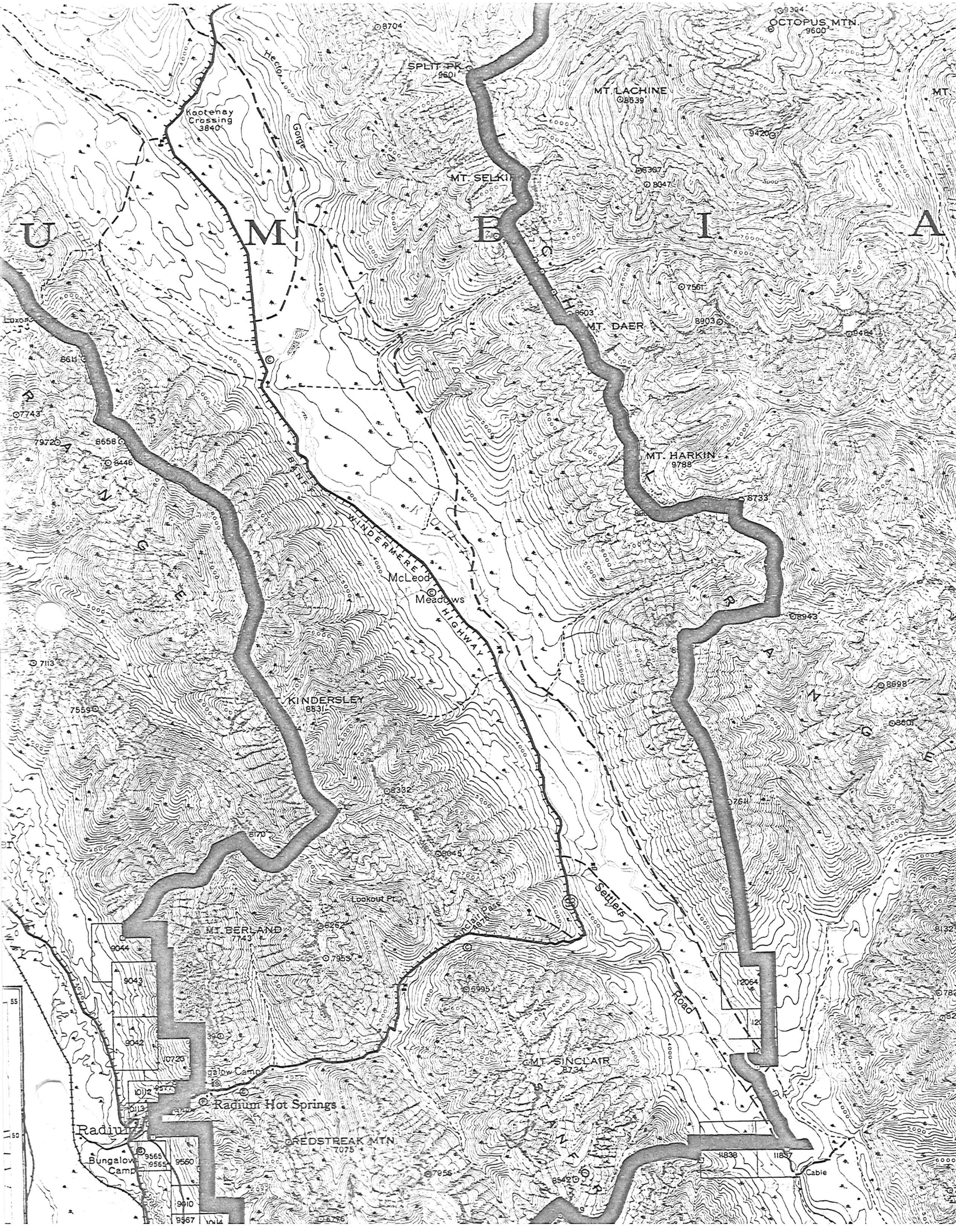
8. Explain present condition of road (clay type base, some potholes good in dry season, muddy when wet).

   Would you be more inclined to use the trail if it was hard surfaced?

   Yes______ No______

9. What recreation options (if any) would you lke to see along the trail?

   Picnic sites ______
   Camp sites ______
   Self guided nature walks ______
   Other ____________________


OCTOPUS MTN.
9600
9394
8704
SPLIT PK.
9601
MT. LACHINE
8639
Kootenay Crossing
3840
Hector
Gorge
9420
8047
U
M
B
I
A
7561
8603
MT. DAER
8903
9484
8611
7743
7972
8658
8446
MT. HARKIN
9788
8733
BANFF
WINDERMERE
HIGHWAY
McLeod
Meadows
8943
7113
KINDERSLEY
8831
7559
8698
8601
8332
7611
8170
9045
Lookout Pt.
Settlers
Road
MT. BERLAND
7743
8262
7953
9044
9043
9042
10720
12064
5995
MT. SINCLAIR
8734
Radium Hot Springs
Radium
REDSTREAK MTN
7075
Bungalow
Camp
9565
9560
9910
9567
7956
8542
11838
11837
Cable
8132

APPENDIX B

Ministry of Natural Resources

Ontario

Your file:

November 28th, 1978

Our file: OPS 5.14

Mr Gordon MacRae
General Delivery
Castlegar, B.C.

Dear Mr MacRae:

Thank you for your letter dated November 25th, 1978 regarding our bicycle trails at Wasaga Beach Provincial Park.

For your information, I have enclosed one of our bicycle brochures, which outlines the route and distance, and provides a brief description of some of the points of interest along the way.

While it is difficult for us to determine the actual number of cyclists using our trails, I believe it is generally understood that this form of recreation has taken a dramatic increase in the last couple of years. Perhaps you should consider contacting a couple of the major bicycle manufacturers to obtain information on the percentage increase in their sales.

Structurally, our trails are six (6) feet wide and consist of four (4) inches of limestone screenings (stonedust), which makes our construction cost, including excavation, $3.00 per lineal foot.

You may also wish to contact the Superintendent at Bronte Creek Provincial Park, 1470 Bronte Road, Oakville, Ontario who operates similar bicycle trails, as well as a bicycle rental concession.

I trust you will find this information useful and I wish you luck on your report.

Yours truly,

G.N.Babcock, Park Superintendent
Wasaga Beach Provincial Park
Box 183, Wasaga Beach, Ontario
LOL 2PO Telephone: (705)429-2516

GNB/sd
encl -1

PARKS CANADA WESTERN REGION TRAIL STANDARDS

TRAIL TYPE: Bicycle Path LOCATION: ____________

USE TYPE: (Separate trail for exclusive use of bicycles. Pedestrian and motorist crossflow and conflict minimized.)

LEVEL:

DURATION:

GRADES DESIRABLE: 0 - 3%

MAX SUSTAINED: 5% not more than 90 m

MAX FOR SHORT PITCHES: 12% up to 30 m

DIMENSIONS WIDTH-RIGHT-OF-WAY: 30 to 50 cm from edge of road

HEIGHT-OVERHEAD: 2.5 to 3 meters

TREAD: 1.5 meters for one way; 2.5 meters for two way

CORNER RADII AND SUPERELEVATION: These vary with grade and average speed
See main text, page 234.

SURFACING: Asphaltic concrete or compacted gravel aggregate or combinati
over gravel base.

RELATED FACILITIES:

STRUCTURES: Bridges .6 m wider than tread adjoining.
Railings adjacent to steep slope or hazardous water.

DRAINAGE MEASURES: outsloping, crowning, ditches, dips, culverts

TRAIL TYPE: Bikelane LOCATION: ______

(adjacent to motorist or pedestrian right-of-way but separated by lines and signs or slight elevation from surrounding grade. A thru lane for bikes only in Visitor Service Centre where bicycling may be an important element in local traffic.)

USE TYPE:

LEVEL:

DURATION:

GRADES DESIRABLE: as for adjacent roads or sidewalks.

MAX SUSTAINED:

MAX FOR SHORT PITCHES:

DIMENSIONS WIDTH-RIGHT-OF-WAY: for one way traffic, 30 to 50 cm beyond tread edge
for two way traffic, 30 to 50 cm beyond tread edge

HEIGHT-OVERHEAD: 2.5 to 3.5 meters

TREAD: for one way traffic, 1.1 wide
for two way traffic, 2.2 wide

CORNER RADII AND SUPERELEVATION: These vary with grade and average speed. See main text, page 234.

SURFACING: Asphaltic concrete over gravel base.

RELATED FACILITIES:

STRUCTURES: Bridges .6 m wide then tread adjoining. Railing adjacent to steep slope or hazardous water.

DRAINAGE MEASURES: outsloping, crowning, ditches, dips, culverts

4.9
Bicycle Trails
Two types of bicycle trails are considered here. The first is the park bicycle trail which is a short-to-medium distance trail contained within a single park, and the second is the long distance or touring bicycle trail.

Park bicycle trails
Bicycles can play an important role within parks. Transportation is often required for providing access to secondary development areas (campgrounds, swimming areas, etc.), which are remote from the park visitor reception centres. In many cases bicycles could be used instead of, or in addition to, private cars or park operated vehicles.

There are many advantages to bicycle use. Construction costs for bicycle trails are considerably less than those for roads and the amount of disruption to the environment, both during and after construction, is less. In addition, bicycle use is better suited to the character of natural settings and will serve as an element of park interest.

There can also be advantages to encouraging bicycle use in conjunction with automobiles since this could reduce the volume of automobile traffic. Bicycles could either share roads with automobiles or be accommodated separately on trails.

The key objective for developing bicycle trails within national parks should be to assist in providing for the access requirements of parks. It is not feasible to develop bicycle trails primarily as a recreation resource for cycling enthusiasts. An experienced cyclist can easily travel 60 km a day and to try to provide enough trail for even one full day of cycling, let alone for overnight excursions, would be quite prohibitive (costs presently run at a minimum of $5600.00 per km). It is also likely that the development of extensive bicycle trail systems would be in conflict with the generally accepted conservation philosophy of national parks. This type of cycling experience will probably be best provided by long-distance touring trails developed on a regional scale.

4.9
Pistes cyclables
Nous examinerons ici deux types de pistes cyclables. La première, la piste cyclable de parc, est une piste de faible ou moyenne longueur située à l'intérieur d'un seul et même parc; la seconde est la piste cyclable de longue distance ou piste d'excursion.

Pistes cyclables de parc
Les bicyclettes peuvent être très utiles dans les parcs. Il est souvent nécessaire de posséder un moyen de transport permettant l'accès aux aménagements secondaires (terrains de camping, secteurs affectés à la baignade, etc.) situés à une certaine distance des centres d'accueil aux visiteurs. Dans beaucoup de cas, les bicyclettes pourraient être utilisées à la place des voitures particulières ou des véhicules exploités par les parcs, ou encore en même temps que ces derniers.

L'utilisation de la bicyclette comporte beaucoup d'avantages. Les coûts de construction des pistes cyclables sont de beaucoup inférieurs à ceux des routes et l'importance des perturbations occasionnées à l'environnement, dans leur cas, aussi bien durant la construction qu'après, est aussi moindre. En outre, la bicyclette est mieux adaptée au caractère naturel d'un parc en plus de constituer un élément d'intérêt additionnel pour le parc en question.

On a aussi avantage à encourager l'utilisation de la bicyclette de concert avec celle de l'automobile: cette pratique pourrait en effet permettre de réduire la circulation automobile. Pour ce faire, il serait possible, soit de faire partager aux bicyclettes les routes avec les automobiles, soit de les faire circuler sur des pistes séparées.

Le principal objectif de l'aménagement de pistes cyclables à l'intérieur des parcs nationaux devrait être d'aider à satisfaire aux exigences relatives à l'accès des parcs. Il n'est pas possible d'aménager des pistes cyclables dans le seul but d'offrir une ressource de loisir aux mordus de la bicyclette. Les cyclistes expérimentés peuvent en effet parcourir facilement 60 km par jour; il serait donc plutôt prohibitif (les coûts minimaux s'élevant actuellement à $5600 le km) d'essayer de mettre à leur disposition, même pour une seule journée entière de cyclisme, (sans parler des excursions s'étendant sur plusieurs jours), une longueur de piste suffisante. Il est d'ailleurs probable que l'aménagement de systèmes étendus de pistes cyclables irait à l'encontre de la philosophie généralement acceptée des parcs nationaux en matière de conservation. C'est probablement avec des pistes d'excursion de longue distance élaborées à l'échelle régionale qu'on sera le mieux en mesure de fournir ce genre d'expérience cycliste.

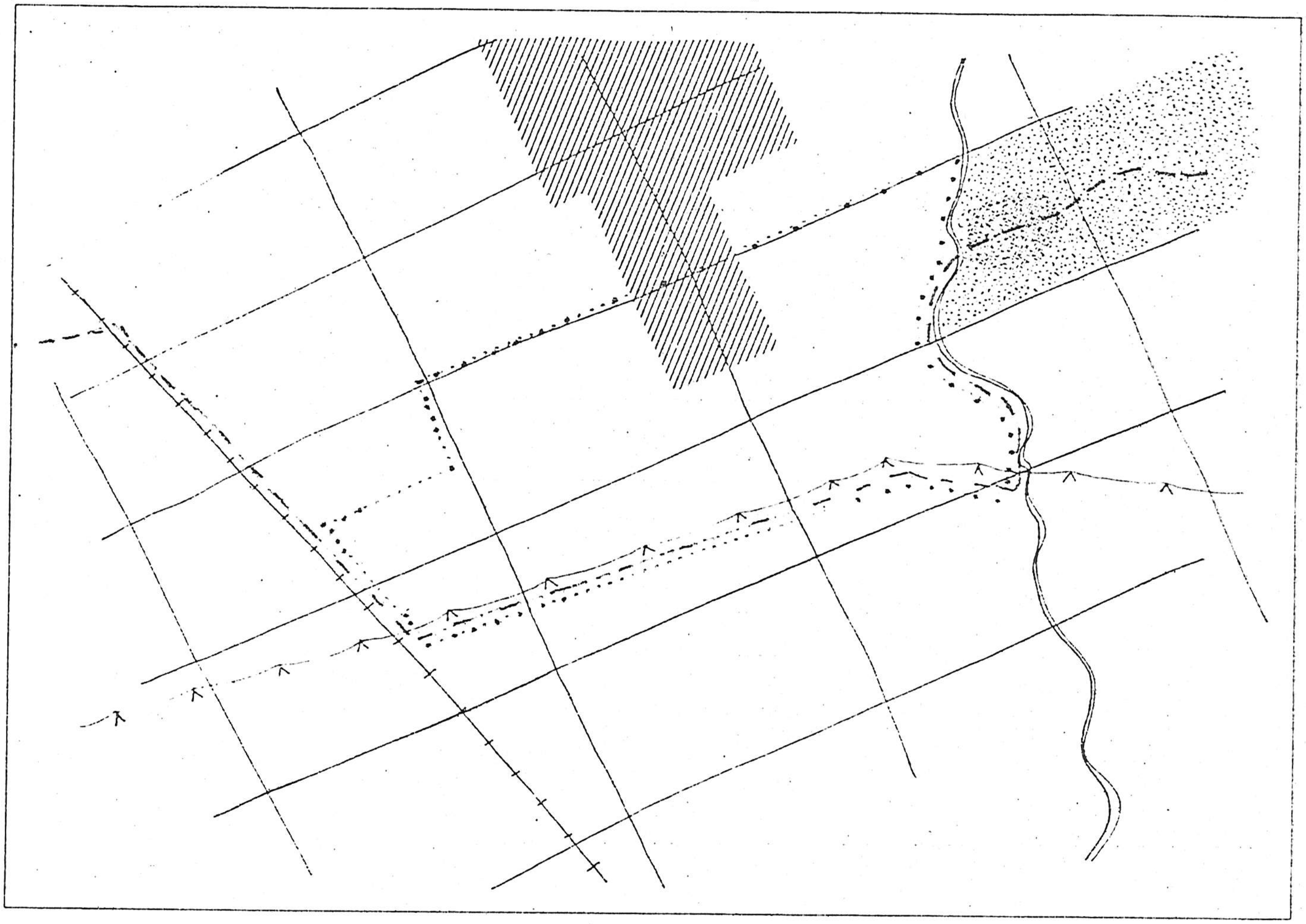
As a general rule in national parks it will be most suitable if bicycle trails are limited to Class 4 and 5 Areas (General Outdoor Recreation and Intensive Use Areas) and to the fringes of Class 3 Areas (Natural Environment Areas). Use should be prohibited from Classes 1 and 2 Areas (Special and Wilderness Areas).

Touring bicycle trails
The concept of the touring trail is similar to that of the front country hiking trail. This could be made up of a series of short trail sections and could be used for day-use, weekend trips or extended trips crossing whole regions or provinces. Such trails would have to be coordinated on an intergovernmental basis. They could be located through various park systems (national, provincial, regional and municipal) as well as along minor roads, unused roads and railway easements, highway and power line transmission easements and rights-of-way granted by private landowners.

En règle générale, dans le cas des parcs nationaux, le mieux sera de limiter les pistes cyclables aux zones de Classe 4 et 5 (Zones de loisirs en plein air et Zones d'utilisation intensive) ainsi qu'aux pourtours des zones de Classe 3 (Zones en pleine nature). On devrait cependant en interdire l'utilisation dans les zones de Classes 1 et 2 (Zones spéciales et Zones à l'état sauvage).

Pistes cyclables d'excursion
La piste d'excursion est, de par sa conception, analogue à la piste de randonnée de l'avant-pays. Elle pourrait être constituée d'une série de courts tronçons de piste et être destinée à l'utilisation diurne, aux voyages de fin de semaine ou aux voyages étendus portant sur la traversée de régions ou de provinces entières. De telles pistes devraient évidemment être coordonnées au niveau intergouvernemental. Elles pourraient traverser divers systèmes de parc (nationaux, provinciaux, régionaux et municipaux), longer des routes secondaires ou inutilisées, des emprises de chemin de fer, des grands-routes et des lignes de transport d'énergie, ou encore traverser les terrains de particuliers ayant accordé un droit de passage.

Touring Bicycle Trail | Piste cyclable d'excursion



Touring bicycle trail	Piste cyclable d'excursion
Day-use loop trail	Piste en boucle d'utilisation diurne
Abandoned railway easement	Emprise de chemin de fer abandonné
Electricity transmission line easement	Emprise de ligne de transport d'énergie
River	Rivière
Roads	Routes
Town or village	Ville ou village
Park	Parc
Campsite areas	Secteurs de camping

The following sections describe planning considerations for both park and touring trails. Bicycle trails, whether park or touring, should be designed to accommodate the average cyclist. The main objective is to provide scenic and interpretive interest by a pleasurable mode of travel, and not to test skill and endurance.

4.9.1
Form of Trail Layout and Alignment

Form of layout
The form most suitable for park bicycle trails will depend upon the particulars of the situation. Where there are a number of points to be linked by the trail a loop type of system is most appropriate. Where the main function of a trail is to provide access to an activity area then a linear system will likely be best. Spur trails can be located off these to provide hiking access to nearby features.

Les sections suivantes décrivent les éléments à prendre en considération pour la planification tant des pistes de parc que des pistes d'excursion.

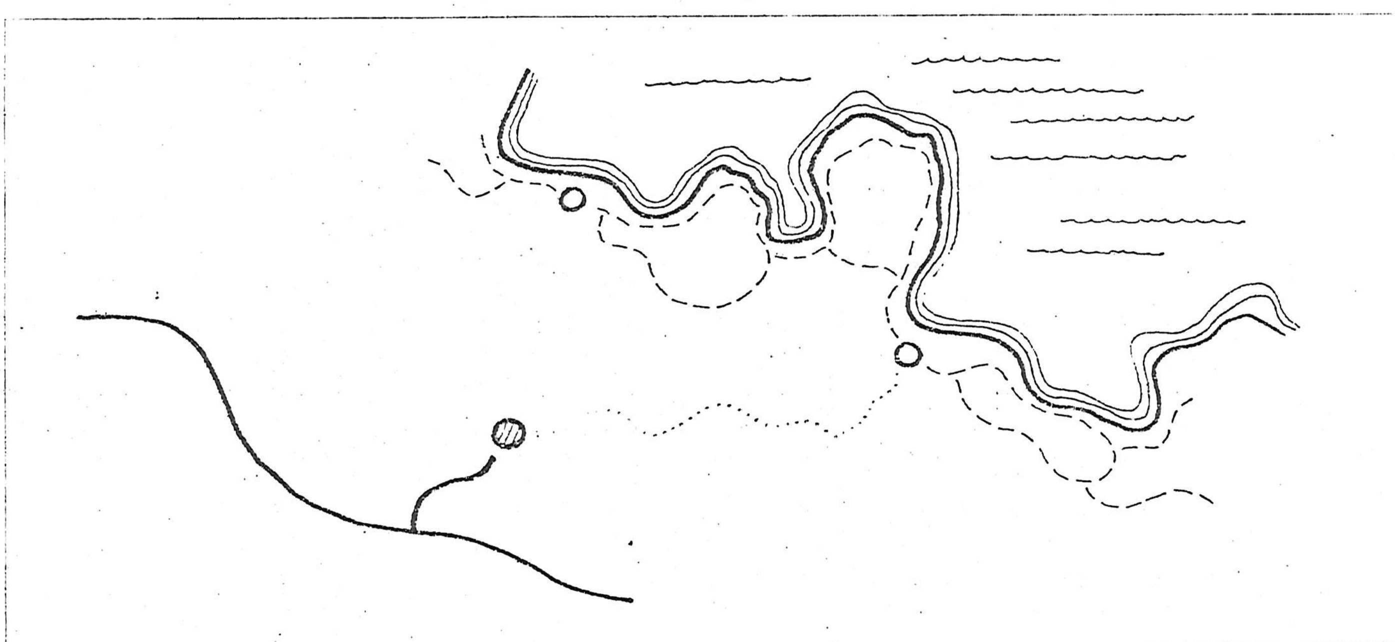
Les pistes cyclables, qu'il s'agisse des pistes de parc ou des pistes d'excursion, devraient être conçues en fonction du cycliste moyen. L'objectif principal est de présenter un intérêt touristique et d'interprétation tout en procurant aux individus une façon agréable de voyager, et non de mettre leur adresse et leur endurance à l'épreuve.

4.9.1
Tracé et alignement des pistes

Tracé
La forme la plus appropriée pour les pistes cyclables de parc dépend des particularités de l'endroit. Lorsqu'il s'agit de relier au moyen d'une piste un certain nombre de points, le système de boucles est celui qui convient le mieux. Si la piste a par contre pour fonction de donner accès à une aire d'activité, un système linéaire représentera probablement la meilleure solution. On peut aussi faire partir de ces pistes des embranchements donnant accès par la marche aux points d'intérêt avoisinants.

Park Bicycle Trail

Piste cyclable de parc



access road — Route donnant accès au parc

Park visitor reception centre — Centre d'accueil aux visiteurs du parc

Secondary activity centres — Centres d'activité secondaire

Bicycle trails — Pistes cyclables

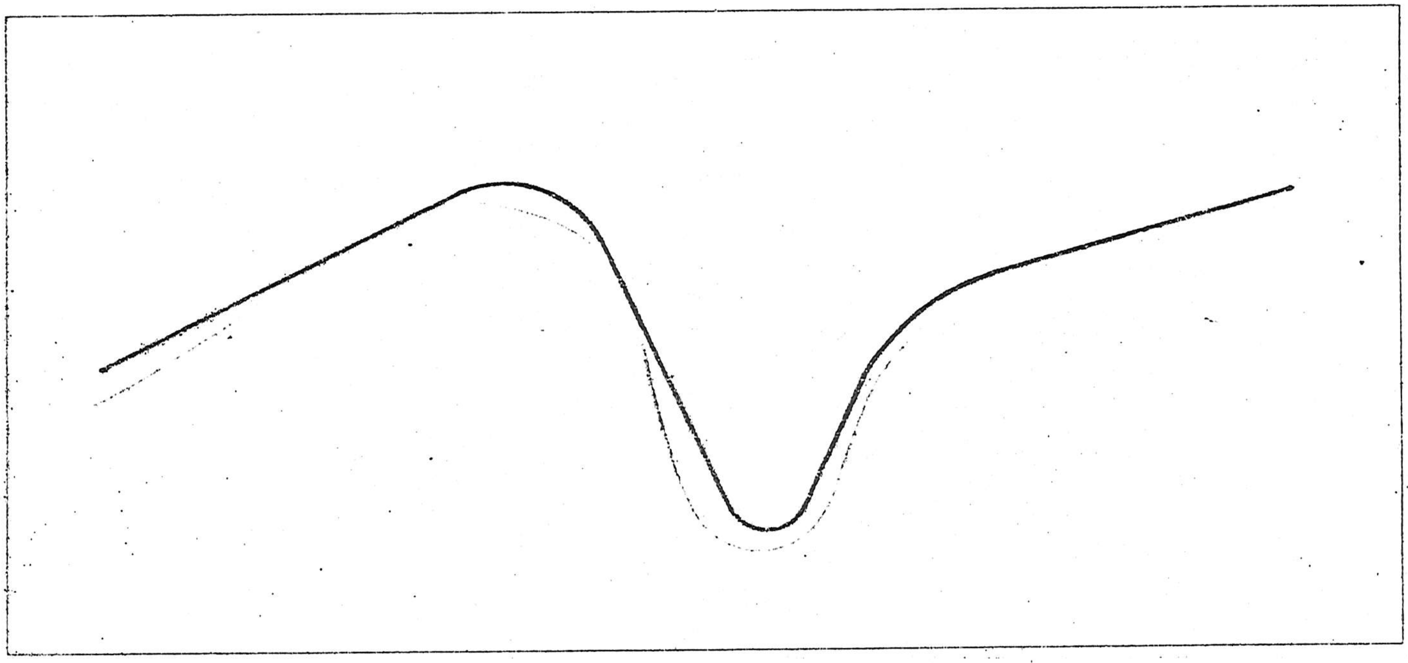
Foot trails — Sentiers piétons

For touring trails the linear form is most suitable, with spurs and loops giving access to features and adjacent communities.

Alignment
The alignment of bicycle trails should be curvilinear and fitted to the natural form of the land. The straight line-curve-straight line type of alignment should be strictly avoided.

Pour les sentiers d'excursion, enfin, la forme linéaire, assortie d'embranchements et de boucles donnant accès aux points d'intérêt et aux collectivités adjacentes, est la mieux adaptée.

Alignement
L'alignement des pistes cyclables doit être curviligne et adapté à la forme naturelle du terrain. Il faudrait absolument éviter l'alignement de type ligne droite - courbe - ligne droite.



Désirable
Curvilinear alignment

Undesirable
Straight line - curve - straight line alignment

Souhaitable
Alignement curviligne

Non souhaitable
Alignement de type ligne droite - courbe - ligne droite

The following guidelines are provided for calculating requirements for the radii and super-elevations (cross slopes) of curves. These are not rigid requirements: tighter curves can be used safely as long as riders can see the need to slow down from an adequate distance.

For trail sections with grades of 0 to 3 percent:

An average downhill speed of 20 km/h is expected. The sharpest curve should have a maximum radius of 10.5 m and should be super-elevated at a rate of 10 percent. Super-elevation diminishes as the radius of curve increases and stops at a radius of 21 m.

Examples:
• for a curve radius of 10.5 m, super-elevation = 10 cm per metre of trail width (10 percent)
• for a curve radius of 16 m, super-elevation = 5 cm per metre of trail width (5 percent)

For trail sections with grades of 4 to 6 percent:

An average downhill speed of 29 km/h is expected. The sharpest curve should have a radius of 24 m and should be super-elevated at a rate of 10 percent. Super-elevation diminishes as the radius of curve increases and stops at a radius of 46 m. (Source: National Capital Commission, Ottawa).

On steep one-way uphill sections curves may have radii of less than 10.5 m and super-elevation is not required.

Trails will be more interesting if a variety of curves are used, i.e. some fairly tight curves interspersed with longer, more generous curves.

Sharp curves should be avoided at the bottom of long or steep slopes in order to prevent cyclists from losing control. Straight 'run out' sections are prefered so speed can be reduced before reaching sharp curves. Visibility on slopes should be clear so that chances of collision are minimized.

Les lignes directrices suivantes permettent de calculer, pour les courbes, les exigences quant aux rayons et aux relèvements de virage (pentes transversales). Il ne s'agit pas là d'exigences rigides: il est possible d'utiliser en toute sécurité des courbes plus serrées en autant que les cyclistes peuvent se rendre compte à une distance suffisante de la nécessité de ralentir.

Pour les tronçons de piste possédant une pente de 0 à 3 pour cent:

Il faut s'attendre à une vitesse moyenne de descente de 20 km/h. Le virage le plus serré devrait alors avoir un rayon de 10.5 m et une surélévation de l'ordre de 10 pour cent. Le relèvement du virage diminue à mesure que le rayon du virage augmente et devient nul lorsque le rayon atteint 21 m.

Exemples:
•pour un virage de 10.5 m de rayon, le relèvement du virage est de 10 cm par m de largeur de piste (10 pour cent).
•pour un virage de 16 m de rayon, le relèvement de virage est de 5 cm par m de largeur de piste (5 pour cent).

Pour les tronçons de piste possédant une pente de 4 à 6 pour cent:

Il faut s'attendre à une vitesse moyenne de descente de 29 km/h. Le virage le plus prononcé devrait alors avoir un rayon de 24 m et une surélévation de l'ordre de 10 pour cent. Le relèvement du virage diminue à mesure que le rayon du virage augmente et devient nul lorsque le rayon atteint 46 m. (Source: Commission de la Capitale nationale, Ottawa).

Sur les tronçons de piste à sens unique escaladant une pente raide, les virages peuvent avoir moins de 10.5 m de rayon sans qu'un relèvement de virage ne soit nécessaire.

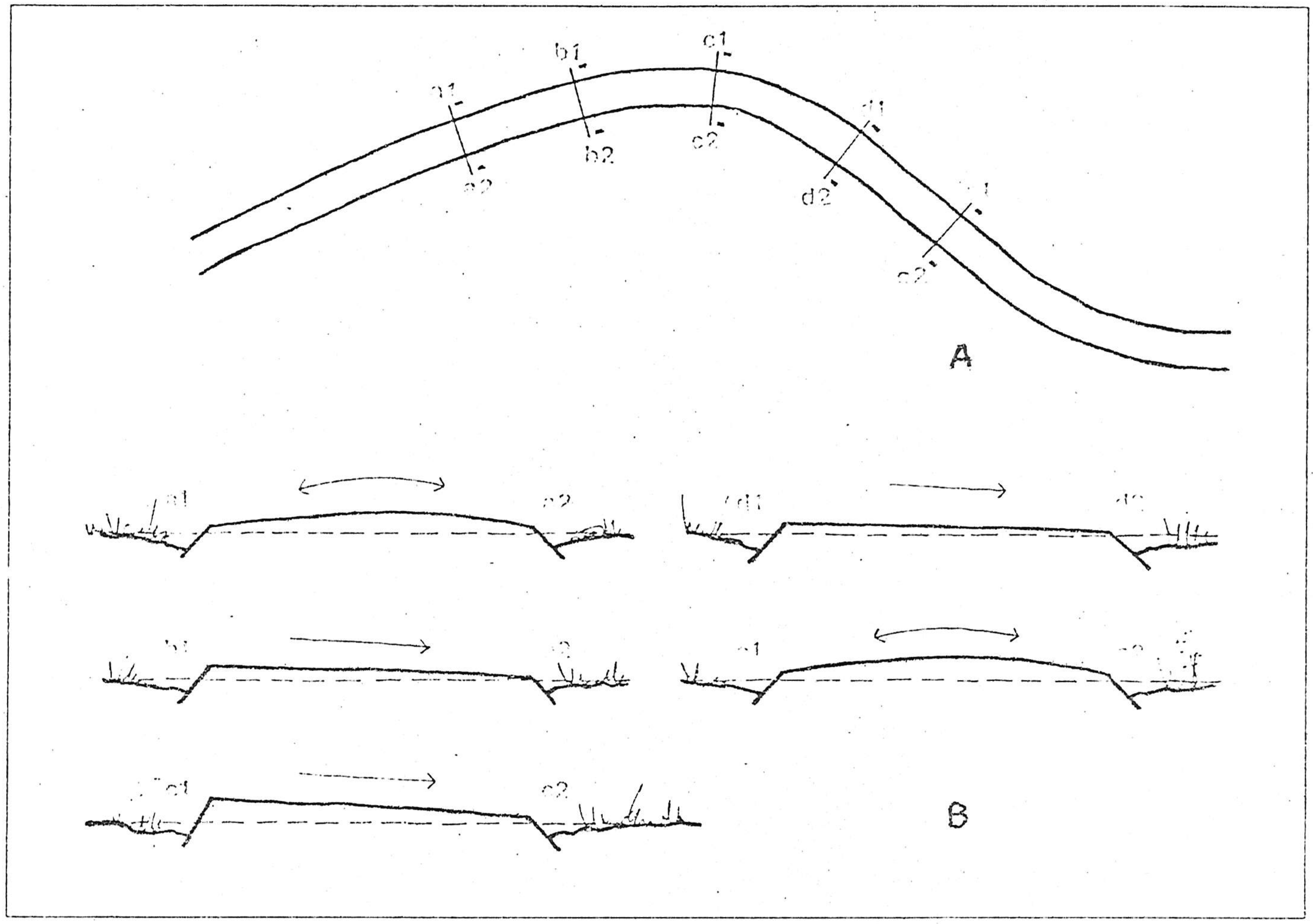
Les pistes seront plus intéressantes si l'on a recours à une certaine variété de virages, soit des virages assez serrés entremêlés de virages plus longs et plus généreux.

On ne doit pas placer des virages serrés au bas des pentes longues et raides afin d'éviter que les cyclistes ne perdent le contrôle de leur bicyclette. Il est préférable que les tronçons pour ralentir soient rectilignes de façon à ce que les cyclistes puissent réduire leur vitesse avant d'atteindre des virages serrés.

Il est en outre nécessaire que la visibilité le long des pentes soit bonne, de façon à minimiser les risques de collision.

Super-elevation on Downhill Curve

Relèvement de virage dans une courbe descendante



A Plan view of curve

B Cross-sections of trail tread

a1-a2 Tread is crowned before curve
b1-b2 Super-elevation begins at start of curve
c1-c2 Maximum super-elevation is at centre of curve
d1-d2 Super-elevation ends
e1-e2 Tread is crowned after curve

A Vue en plan de la courbe

B Coupes transversales de la surface du sentier

a1-a2 La surface est bombée avant la courbe
b1-b2 Le relèvement de virage commence au début de la courbe
c1-c2 Le relèvement de virage maximum est au centre de la courbe
d1-d2 Le relèvement de virage se termine
e1-e2 La surface est bombée après la courbe

4.9.2

4.9.2
Trail Length

Free flowing bicycle traffic averages about 18 km/h and the range of most cyclists falls between 11 and 24 km/h. Therefore, to determine the most suitable length for a day-use trail, or the optimum spacing between camping areas on overnight-use trails, the speed of 18 km/h can be used as a basis for calculation.

Consideration must also be given to the conditions of terrain and features of interest along the trail. If there are many hills to climb, or features which are likely to entice cyclists to stop, travel distances should be reduced.

On touring trails camping facilities should be located fairly close together. Hostels and larger campgrounds should be spaced at intervals which can be easily travelled by the average cyclist in about four hours, i.e. 60-70 km. Smaller camping areas can be situated between these key areas to accommodate persons who may wish to cover lesser or greater distances.

4.9.3
Grades

Desirable range of grades - 0 to 3 percent
Maximum sustained grade - 6 percent preferably for distance not greater than 90 m
Maximum grade for short pitches - 10 percent up to a maximum distance of 30 m

Gently rolling terrain is most suitable for bicycle trails.

If conditions are rugged, trails may be too difficult for comfortable use, and construction costs may be very high. Flat terrain can be monotonous. Ideally the trail should provide a variety of conditions. A few steep grades and tight curves will give some challenge and excitement; these should be interspersed with gentle grades and longer curves.

At the top of steep or long slopes 'pull offs' should be provided so cyclists can stop to rest without blocking the way. These are also good locations for benches or logs for people to sit on.

4.9.2
Longueur des pistes

La circulation cycliste, lorsqu'elle n'est entravée par aucun obstacle, permet une vitesse moyenne d'environ 18 km/h alors que celle de la plupart des cyclistes se situe entre 11 et 24 km/h. C'est pourquoi la base de calcul pour déterminer la meilleure longueur d'une piste d'utilisation diurne ou encore l'espacement optimal entre les secteurs de camping situés sur les pistes de plus d'une journée de parcours, est la vitesse de 18 km/h.

On doit aussi tenir compte des conditions du terrain et des points d'intérêt le long de la piste. S'il y a beaucoup de collines à franchir ou de points d'intérêt pour le cycliste, il est nécessaire de réduire les distances à parcourir.

Sur les pistes d'excursion, les aménagements de camping devraient être assez près les uns des autres. Les auberges et les terrains de camping plus importants devraient, pour leur part, être situés à des intervalles correspondant à la distance que peut facilement couvrir le cycliste moyen en environ quatre heures, soit entre 60 et 70 km. On peut placer entre ces endroits principaux des secteurs de camping plus petits destinés aux personnes désirant parcourir des distances moindres ou supérieures.

4.9.3
Déclivités

Déclivité souhaitable - 0 à 3 pour cent
Déclivité maximum pour des pentes soutenues - 6 pour cent, de préférence pour des distances ne dépassant pas 90 m
Déclivité maximum pour de courtes distances - 10 pour cent sur une distance maximum de 30 m

Un terrain légèrement inégal est celui qui se prête le mieux aux pistes cyclables. Si le terrain est trop accidenté, les pistes peuvent s'avérer trop difficiles à parcourir et imposer des coûts de construction très élevés. Un terrain plat risque par contre d'être monotone. Idéalement, il est nécessaire que la piste offre une certaine variété de conditions. Quelques pentes raides et des courbes serrées proposeront un certain défi et susciteront l'enthousiasme; on devrait les intercaler entre des pentes douces et de longues courbes.

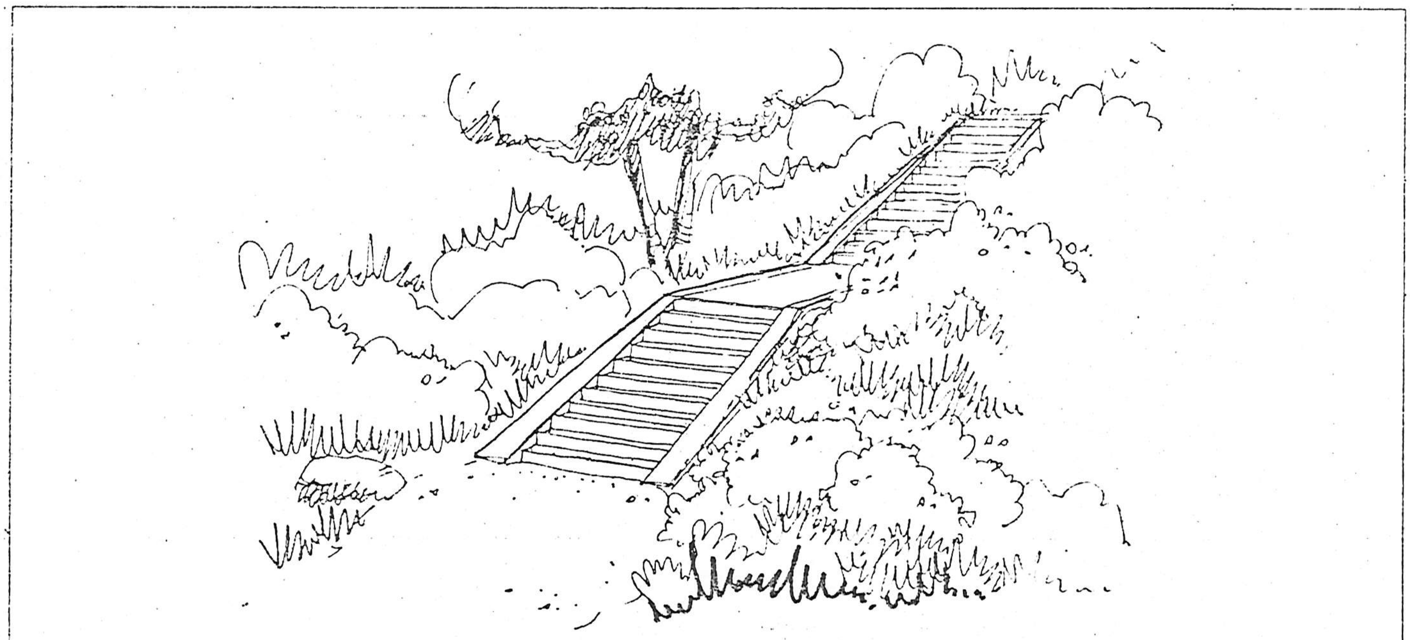
Il faudrait prévoir, au haut des pentes raides ou longues, des espaces en retrait permettant aux cyclistes de s'arrêter pour se reposer sans bloquer le chemin. Ces endroits se prêtent bien aussi à la pose de bancs ou de billots de bois sur lesquels les gens puissent s'asseoir.

Where grades of over ten percent cannot be avoided it may be desirable to provide steps so that large scale grading operations, which are unsightly and costly, can be avoided. Narrow paths or ramps should be built on either side of stairways for the cyclists to wheel their bicycles as they walk up or down the steps. Landings should be provided on long climbs. Cyclists must have adequate forewarning of steps, especially for approaches from the top. Views should be clear, i.e. no sharp bends, and there should be warning signs. Since signs can be removed by vandals there should be additional means of alerting cyclists, such as a change in trail surfacing or a gate at the top of the steps.

Là où il n'est pas possible d'éviter une déclivité de plus de 10 pour cent, il peut être souhaitable d'installer un escalier, afin de ne pas avoir à recourir à des travaux de nivellement de grande envergure qui sont laids et coûteux. On devrait en outre construire, de l'un ou l'autre côté de l'escalier, un sentier étroit ou une bretelle permettant aux cyclistes de faire rouler leur bicyclette à côté d'eux pendant qu'ils montent ou descendent l'escalier. Il faudrait même prévoir des paliers dans le cas des longues montées. Les cyclistes doivent être avertis à l'avance et de façon adéquate de la présence d'un escalier, surtout lorsqu'ils approchent du haut de ce dernier. L'escalier devrait être bien visible; il ne devrait donc pas y avoir de virages serrés avant d'y arriver et on devrait l'annoncer au moyen de panneaux avertisseurs. Comme les panneaux peuvent être enlevés par des vandales, il est nécessaire, pour alerter les cyclistes, de recourir à des moyens additionnels tels qu'un changement dans le revêtement de la piste ou une barrière au haut de l'escalier.

Steps for Bicycle Trails

Marches pour pistes cyclables



Tread surfaces should be cross sloped at a rate of two percent for drainage purposes (see also section 4.9.1, Alignment). Where little water is expected from uphill areas drainage can be allowed to run across the trail. Where a large amount of water can be expected a ditch should be dug on the uphill side of the trail to intercept the runoff and the tread should be crowned at a rate of two percent.

La surface des pistes devrait comporter une pente transversale de l'ordre de deux pour cent, pour des raisons de drainage (voir la section 4.9.1, "Alignement"). Aux endroits où on ne s'attend qu'à un faible ruissellement en provenance des secteurs plus élevés, on peut laisser l'eau de drainage passer par-dessus la piste. Par contre, là où on peut s'attendre à un ruissellement plus abondant, il est nécessaire de creuser un fossé pour intercepter ce ruissellement du côté de la piste donnant sur le secteur le plus élevé. La surface des pistes devrait, dans ce cas, comporter un bombement de l'ordre de deux pour cent.

4.9.4

4.9.4
Tread Width
Bicycles are approximately 60 cm wide and require another 60 cm of room to accommodate their irregular pattern of movement. The minimum width for a one-way trail should be 1.2 m. However a width of 2.5 m is more suitable because it provides for two lanes of traffic, with the extra lane allowing room for passing or for cyclists to ride side-by-side.

On heavy use trails which are to be shared with pedestrian traffic the tread width should be a minimum of 3 m.

4.9.5
Right-of-Way Clearing
Obstructions such as tree trunks and sign posts should be kept back 30 cm from the edges of the tread. Low growing vegetation should be left up to the tread. A clearing height of 2.5 m should be maintained.

There must be adequate visibility at intersections with roads and other trails, on sharp curves and at the bottom long or steep slopes.

4.9.6
Tread Surfacing
Surfacing for bicycle trails must be firm and smooth. The best materials for these requirements are asphalt (plain or with rolled-in stone chip finish) or crushed stone (with a stone-dust finish). Loose gravel or stone are not satisfactory.

Asphalt and crushed stone surfaces each have advantages. Asphalt is less likely to become rutted and may give a slightly smoother ride. However crushed stone is cheaper, is easier to repair (by regarding) and does not look patchy when repaired.

A suitable approach may be to construct a trail with crushed stone initially and to apply asphalt later if the stone proves unsatisfactory. This has an added advantage in that areas needing additional base material can be identified before the asphalt layer is applied.

Requirements for depth of surfacing and degree of compaction will depend upon the conditions of the subsoil and whether trails will be used by service vehicles, or for snowshoeing or skiing. Engineering expertise should be used to determine these requirements.

4.9.4
Largeur de la surface des pistes
Les bicyclettes ont approximativement 60 cm de large et les mouvements irréguliers qui les caractérisent requièrent 60 cm de plus. La largeur minimale d'une piste à sens unique devrait donc être de 1,2 m. Il est cependant préférable qu'elle ait 2,5 m de large; elle offre ainsi deux voies de circulation, qui alloue aux cyclistes une voie supplémentaire assez large pour doubler ou aller côte à côte.

Sur les pistes très achalandées destinées à être partagées avec les piétons, la largeur devrait être d'au moins 3 m.

4.9.5
Dégagement de l'emprise
Les entraves à la circulation telles que les troncs d'arbres et les panneaux indicateurs devraient être éloignées d'au moins 30 cm du bord de la surface des pistes. On devrait cependant laisser la végétation basse s'étendre jusqu'au bord de la surface des pistes. Il est nécessaire aussi d'assurer une hauteur de 2.5 m.

La visibilité, enfin, doit être satisfaisante, tant aux intersections des routes et autres pistes que dans les courbes serrées et au bas des pentes longues et raides.

4.9.6
Revêtement de la surface des pistes
Le revêtement des pistes cyclables doit être ferme et lisse. Les matériaux les mieux adaptés à ces exigences sont l'asphalte (employé seul ou avec un fini de criblures de pierre) ou la pierre concassée (comportant un fini en poussière de pierre). Le gravier lâche ou la pierre ne sont pas satisfaisants.

Les surfaces d'asphalte et de pierre concassée possèdent chacune des avantages. L'asphalte est moins susceptible de permettre la formation d'ornières et rend sans doute le roulement légèrement plus doux. La pierre concassée est cependant meilleur marché, plus facile à réparer (par renivelage) et n'offre pas, une fois réparée, un aspect rapiécé.

Il vaudrait peut-être mieux construire à l'origine une piste recouverte de pierre concassée et y appliquer par la suite de l'asphalte si la pierre s'avère insatisfaisante. Ceci permet d'identifier, avant que l'asphalte ne soit appliqué, les endroits exigeant des matériaux de fondation additionnels.

Les exigences au niveau de l'épaisseur du revêtement et du degré de compaction du sol dépendront des conditions du sol sous-jacent et de l'utilisation qu'on compte faire des pistes, à savoir si elles seront utilisées par les véhicules d'entretien ou pour faire de la raquette et du ski. Enfin, on devrait faire appel aux ingénieurs pour déterminer ces exigences.

4.9.7
Structures

Bridges are the main type of structure involved in the development of bicycle trails.

The surfacing of bridges should be non-slip, e.g. brushed concrete, asphalt with imbedded stone chips or rough-sawn timber set at right angles to the direction of travel. Junctions between bridge decks and trail surfaces should be level.

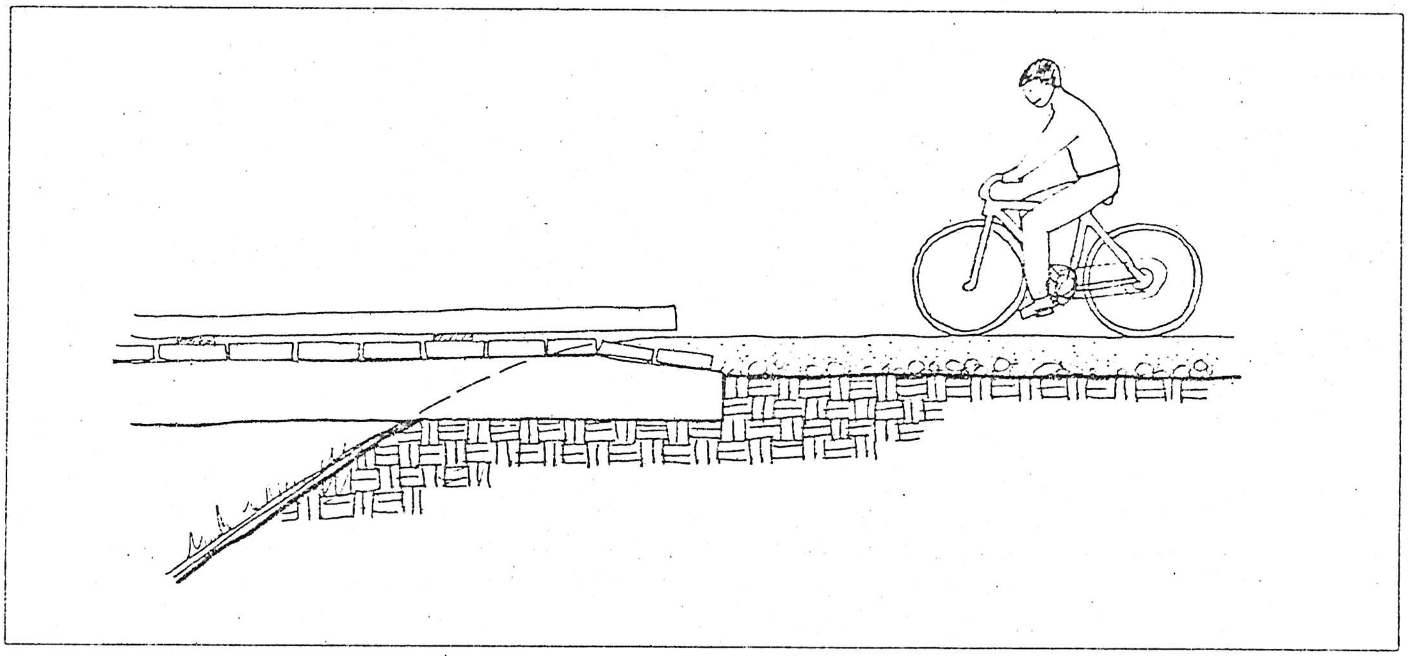
4.9.7
Structures

Les ponts sont le principal type de structure lié à l'aménagement des pistes cyclables.

Le revêtement des ponts devrait être antidérapant par l'utilisation, par exemple, de béton brossé, d'asphalte garnie de criblures de pierre ou de poutres grossièrement sciées disposées perpendiculairement à la direction de la circulation. Les joints entre la surface des pistes et les tabliers des ponts devraient être de même niveau.

Bridges for Bicycle Trail

Ponts pour pistes cyclables

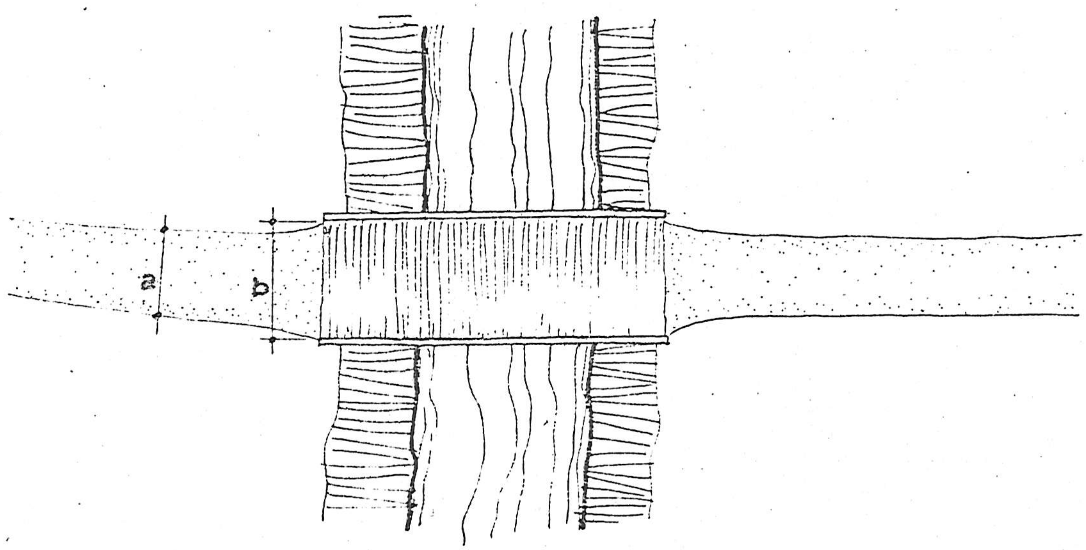


Where there are railings bridge widths should be 60 cm wider than the normal trail tread to allow for the overhang of handle bars. On frequently used trails there should be an additional 60 cm so cyclists can stop without blocking traffic.

Aux endroits où il y a des ponts à balustrades, la largeur devrait être de 60 cm plus large que la normale pour permettre le passage des guidons. Sur les pistes utilisées fréquemment, on devrait prévoir 60 cm de plus pour permettre aux cyclistes de s'arrêter sans entraver la circulation.

Bridges for Bicycle Trails

Ponts pour pistes cyclables



Plan view of bridge
a Trail tread width
b Width of deck between railings (b = a + 60 cm)

Vue en plan d'un pont
a Largeur de la surface du sentier
b Largeur du tablier entre les garde-fous (b = a + 60 cm)

Wheel stops should be installed on bridges where railings are not required. These should be a maximum height of 15 cm so that pedals do not hit them.

Bridges should not be located at the bottom of steep or long grades since cyclists could run into people stopped on bridges.

4.9.8
Facilities
A variety of accommodation should be provided on touring trails. Campgrounds or hostels could be established by public agencies, e.g. in national, provincial, regional and municipal parks, or by private landowners. In many cases there may be existing facilities which can be utilized. Bicycle repair facilities, grocery stores, etc., should be available at or near major camping areas.

On devrait enfin installer des parapets bas sur les ponts où des balustrades ne sont pas nécessaires. Les parapets ne devraient pas excéder 12 cm de hauteur afin que les pédales ne les touchent pas.

Les ponts ne devraient pas être situés au bas de pentes longues et raides en raison du danger pour les cyclistes de frapper des gens qui s'y seraient arrêtés.

4.9.8
Commodites
Il est nécessaire d'offrir, sur les pistes d'excursion, toute une variété de commodités. Les terrains de camping ou les auberges pourraient être établis par des organismes publics, dans les parcs nationaux, provinciaux, régionaux et municipaux par exemple, ou par des propriétaires de terrains privés. Dans beaucoup de cas, il peut être possible d'utiliser des installations déjà existantes. Il devrait y avoir, dans les secteurs de camping principaux ou près de ces derniers, des installations pour la réparation des bicyclettes, des épiceries, etc.

Smaller camping areas should be located between major camping areas. In most cases these would be unsupervised, and therefore should not be located within easy access of vandals, e.g. near intersections with roads.

Parking lots should be provided at key points for use by persons who wish to do extensive touring (preferably where there would be some degree of supervision). 'Pull offs' should be provided at some road crossings for day-use.

Access to trails at road intersections should be blocked to automobile traffic. A narrow passage can be provided for bicycles and a locked gate can be used where access for service vehicles is required (see section 1.3.1, 4).

Bicycle stands should be provided at major stopping points (campsites, viewing positions and entrances to foot trails).

4.9.9
Additonal Safety Factors
Precautions should be taken to protect cyclists at road crossings. All crossings should be signed both on the trail and on the road. Where there is not clear visibility for a minimum distance of 300 m in both directions along the road, cyclists should be required to walk across it.

At junctions with major highways, overpasses or underpasses should be constructed, or the route should be laid out to utilize such existing structures. Suitable crossing points should be considered in the initial planning of bicycle trails.

Les petits secteurs de camping devraient être situés entre les secteurs de camping principaux. Dans la plupart des cas, ceux-ci ne seraient pas surveillés; ils ne devraient donc pas être dans des endroits facilement accessibles aux vandales, près d'intersections de routes par exemple.

Il devrait y avoir des parcs de stationnement aux endroits stratégiques, à l'intention des personnes désirant faire des excursions d'envergure (de préférence aux endroits où il existe une certaine surveillance). On devrait aussi prévoir, à certains carrefours, des espaces en retrait destinés à l'utilisation diurne.

Il est nécessaire de faire en sorte que la circulation automobile ne puisse pas pénétrer sur les pistes, aux intersections des routes. On peut prévoir, à cette fin, un passage étroit destiné aux bicyclettes et une barrière fermée à clef aux endroits où il est nécessaire que les véhicules d'entretien aient accès à une piste (voir la section 1.3.1.4).

On devrait enfin prévoir des supports de bicyclettes aux points d'arrêt des cyclistes (emplacements de camping, points d'observation et entrées des sentiers piétons).

4.9.9
Facteurs additionnels de sécurité
On devrait veiller à protéger les cyclistes aux carrefours routiers qui devraient comporter des panneaux de signalisation, sur les pistes aussi bien que sur les routes. Aux endroits où la visibilité, le long d'une route, n'est pas dégagée sur au moins 300 m dans les deux directions, on devrait obliger les cyclistes à traverser à pied.

Aux croisements des routes principales, on peut construire, pour permettre le passage des cyclistes, des viaducs ou des tunnels, ou aménager le parcours en utilisant les structures déjà existantes. Il faudrait prévoir des carrefours appropriés lors de la planification initiale des pistes cyclables.

Selected Bibliography

Trails and Handicapped Persons

Beechel, Jacque, *Interpretation for Handicapped Persons*, National Park Service, Pacific North West Region, College of Forest Resources, Seattle, WA, U.S.A., 1975.

National Research Council, *Building Standards for the Handicapped*, Supplement No. 5 to the National Building Code of Canada, NRC No. 13990, Ottawa, Ontario, Canada, 1975.

Rehabilitation International, *Barrier Free Design*, New York, New York, U.S.A., 1975.

United States Department of Housing and Urban Development, Office of Policy Development and Research, *Barrier Free Site Design*, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., U.S.A., 1976.

Cross Country Ski Trails

Allaben, Lee, *For a Better Trail (track setting and maintenance)*, 1976 Guide to Cross Country Skiing, Ski Magazine, Times Mirror Magazines, New York, New York, U.S.A., 1976.

Sylvain, Jean, *Normes d'aménagement ski de fond*, Ministères des Terres et Forêts, Direction de la Conservation, Québec, Québec, Canada, 1973.

Equestrian Trails

Vogel, Charles, *Trails Manual*, Equestrain Trails Inc., North Hollywood, California, U.S.A., 1971.

Bicycle Trails

Bicycle Institute of America, *New Switches for Old Railroads*, Arlington Heights, Illinois, U.S.A.

Cook, Walter L., *Bike Trails and Facilities: A Guide to their Design, Construction and Operation*, National Recreation and Parks Association, Arlington, Virginia, U.S.A.

The Institute of Transportation and Traffic Engineering, *Bikeway Planning Criteria and Guidelines*, Department of Engineering, University of California, Berkley, California, U.S.A., 1972.

National Recreation and Parks Association, *Bikeways, Design-Construction-Programs*, No. 10022, Special Publication Series, Arlington, Virginia, U.S.A., 1974.

United States Department of the Interior, *Bicycling and Bicycling Trails, A Trails and Trail Based Activities Bibliography*, Office of Library Services, Washington, D.C., U.S.A., 1971.

United States Department of the Interior, Bureau of Outdoor Recreation, *Bicycling*, United States Government Printing Office, Washington, D.C., U.S.A., 1974.

Sentiers et personnes handicapées

Beechel, Jacques, *Interpretation for Handicapped Persons*, National Park Service, Pacific North West Region, College of Forest Resources, Seatle, Wa, U.S.A., 1975.

Conseil national de Recherches du Canada, *Normes de bâtiments pour les handicapés*, Supplément nº 5 du Code national du Bâtiment du Canada, CNR nº 13990, Ottawa, Ontario, Canada, 1975.

Rehabilitation International, *Barrier Free Design*, New York, U.S.A., 1975.

United States Department of Housing and Urban Development, Office of Policy Development and Research, *Barrier Free Site Design*, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., U.S.A., 1976.

Sentiers de ski de fond

Allaben, Lee, *For a Better Trail (track setting and maintenance)*, 1976 Guide to Cross Country Skiing, Ski Magazine, Times Mirror Magazines, New York, New York, U.S.A., 1976.

Sylvain, Jean, *Normes d'aménagement-Ski de fond*, Ministère des Terres et Forêts, Direction de la conservation du Québec, Québec, Canada, 1973.

Pistes équestres

Vogel, Charles *Trails Manual*, Equestrian Trails Inc., North Hollywood, California, U.S.A., 1971.

Pistes cyclables

Bicycle Institute of America, *New Switches for Old Railroads*, Arlington Heights, Illinois, U.S.A.

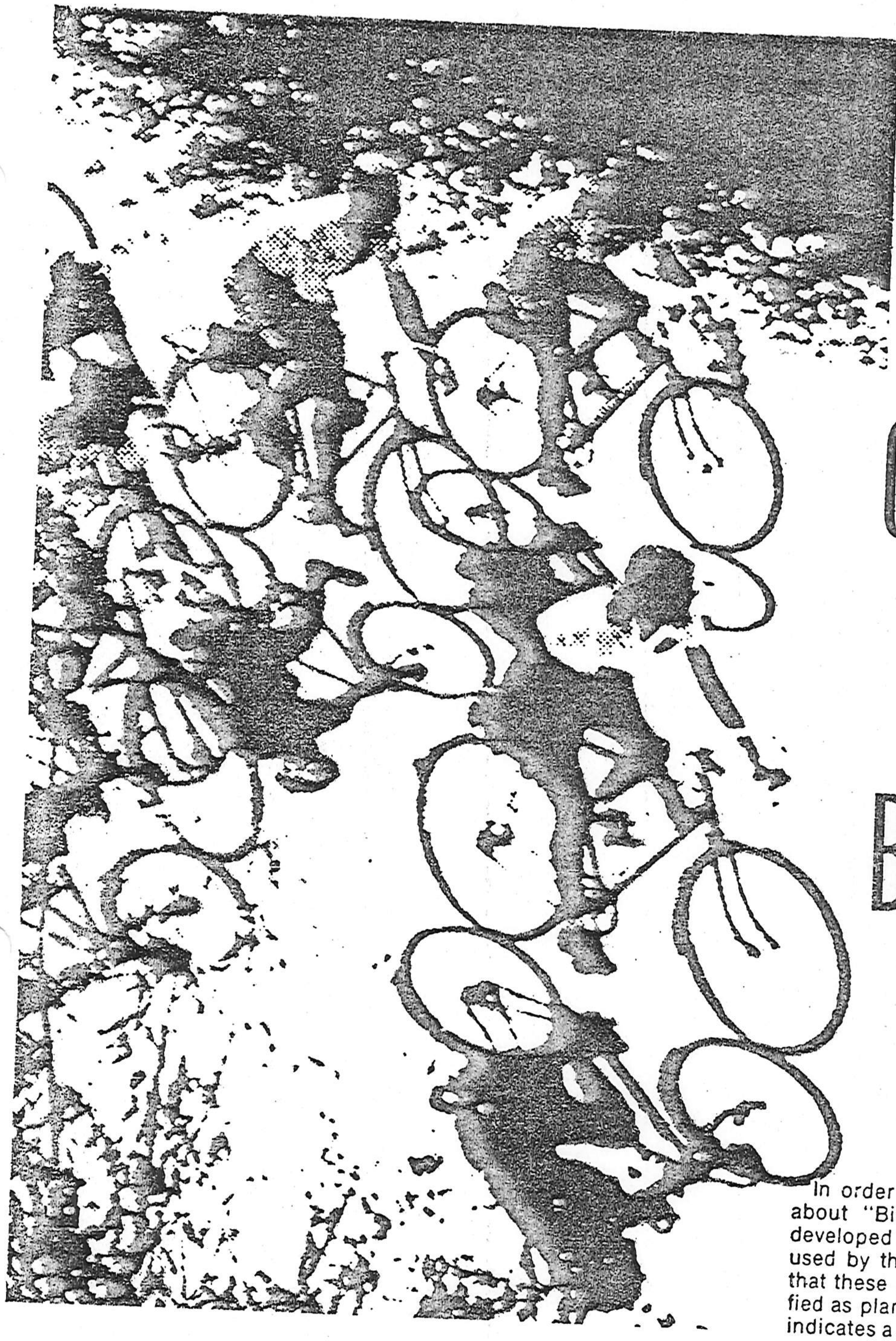
Cook, Walter L., *Bike Trails and Facilities: A Guide to their Design, Construction and Operation*, National Recreation and Parks Association, Arlington, Virginia, U.S.A.

The Institute of Transportation and Traffic Engineering, *Bikeway Planning Criteria and Guidelines*, Department of Engineering, University of California, Berkley, California, U.S.A., 1972.

National Recreation and Parks Association, *Bikeways, Design-Construction-Programs*, No. 10022, Special Publication Series, Arlington, Virginia, U.S.A., 1974.

United States Department of the Interior, *Bicycling and Bicycling Trails, A Trails and Trail Based Activities Bibliography*, Office of Library Services, Washington, D.C., U.S.A., 1971.

United States Department of the Interior, Bureau of Outdoor Recreation, *Bicycling*, United States Government Printing Office, Washington, D.C., U.S.A., 1974.



GUIDELINES FOR BIKEWAYS

In order to establish a common understanding about "Bikeways," these guidelines have been developed by Denver Service Center and are to be used by the National Park Service. It is intended that these guidelines will be revised and/or modified as planning and management of bicycle areas indicates a need to do so.

Introduction

More and more bicycles are arriving in the parks each year. This is probably due to the fact that the production of bicycles has exceeded that of the automobile and the new rider is an adult. Some parks have started providing for the bicycle. An example would be in Yosemite National Park. Visitors are instructed after parking their cars that they can either "hoof it," ride a bicycle, or take a bus to see the wonders of nature. The roads in Yosemite have been marked with signs, "Bicycles and Cars Have Equal Rights on Roads."

In 1972 Senator Alan Cranston (D-Ga.) introduced a Bicycle bill, S.2440. This bill passed the Senate Public Works Committee, but did not reach the floor of the Senate. Probably within the next year a similar bill will be introduced in both the Senate and House. Passage can be predicted. When a bill of this nature passes it will be the first time the Federal government has invested money for the bicycle as a mode of transportation.

Most all parks have a need to create an efficient means for movement of people. There is a need to eliminate, as much as possible, traffic congestion, air and noise pollution.

In the bicycle trail guide of Cape Cod National Seashore, the first statement is, "Bicycling is a healthful and fun way to view the magnificent scenery of the Cape Cod National Seashore." The viewing from a bicycle is a healthy way to see and enjoy the entire National Park System. In the past years many roads and highways have been built in national parks to accommodate the automobile. The future should see more accommodations for bicycles. This involves more planning in many parks in order to make bikeways an integral part of the transportation and pedestrian system of that park.

In 1885, the British Rover "safety bicycle" was introduced and by 1893, the addition of pneumatic tires, roller chain drive, and "diamond" frame evolved the Rover into a form essentially similar to the bicycles of today. Additional sophistications introduced before the turn of the century included the suspension wheel, ballbearings for crank and hubs, weldless steel tubing for the frame, and coaster brakes.

It was around this period of time that the bicycle boom began. In 1900 the bicycle had been reduced in price and could be purchased for less than $20.00. Due to mass production the annual sales in America were around two million. The safety bike enjoyed the privilege of being the fastest thing on the road. Bicycles were made that could change gears. All the experimentation with bicycles helped the idea of the automobile to grow. The bicycle gave the automobile everything that was needed except the engine. It was in a bicycle repair shop that the first American car was made. The Wright Brothers and Henry Ford were some of the more famous bicycle repair men. The owners of these two bike shops had a great deal of influence upon the future history of the world. Mass production is usually associated with Henry Ford, and the Wright Brothers are given credit for the birth of aviation.

After an elapse of half a century the bicycle boom is on once again. Sales in 1972 will exceed the 10 million mark. The future prediction by the Bicycle Institute of America is that there will continue to be an increase for a period of time. Some of the major airlines are beginning to advertise "fly with your bicycle." Many national parks are designed ideally for the bicycle.

The Planning Process

The master plan is designed as an orderly process for development. Any additional development initiated by the park should be in compliance with the master plan or revision should be made to update the existing master plan. The addition of a bikeway in a park requires a certain amount of planning. The planning process is similar whether it is planning a bikeway for a city or for a national park.

The following planning process is by Vincent R. Desimone, a transportation planning engineer, Automobile Club of Southern California.

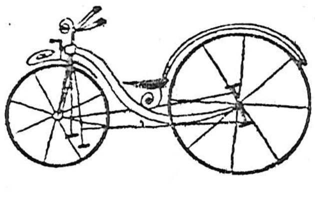
It is necessary to follow all the steps in the transportation planning process in order to determine the proper scale of development and investment for bicycle facilities. Without adequate planning, actions taken to provide facilities for bicycles are more likely to be failures. It is likely that there will be poorly coordinated facilities that do not give the public an adequate return on investment. Plans should be chosen through an examination of alternative strategy.

Any planning which concludes with recommendations of expenditure of public funds must be based upon supportable facts. The first step in the planning process should be to inventory existing bicycle facilities and their use. These inventories should cover travel characteristics, characteristics of the user, land use and the physical facilities available. Forecasts of travel and demand should be made. Once forecasts of use and demand are made, goals can be formulated stating objectives or criterias against which all later proposals can be measured. Some objectives are quantifiable, others are subjective. Whatever course of action is selected, it must be supportive of these objectives.

The next step is to develop proposals for facilities. Having developed the proposals, an evaluation should be made as to the impact that these proposals will have on the goals. Working within the professional and political process, the decisions can be made as to whether a facility should be built and where.

Goals and objectives that should be kept in mind in planning are identified as safety, mobility, efficiency and pleasure. Safety must be provided for the cyclist as well as for the pedestrian and the motorist. Mobility for the cyclist, as well as mobility of the overall transportation system, must be kept in mind since the cyclist and motorist often will hinder each other. Increased efficiency will result in the best use of facilities for the cyclist as well as the motor vehicle. Pleasure should be maximized for the cyclist as well as for the others he interacts with in the operation of his bicycle.

The application of the technical planning process is new to bicycle facility planning. It should be kept in mind that the planning process is iterative requiring trial of various alternatives, followed by improvements incorporated in succeeding trials. To bring the planning process full circle, it is necessary to undertake a continuing evaluation of bicycle facilities as they are put into operation. The wave of interest in bicycles is a new experience for most communities in the United States; and it will require a period of trial and error to determine which facilities are feasible, which are safe, and how much public money can be allocated for their implementation."



Definitions

There are many terms describing right-of-ways for the bicycle. The term "Bikeway" will be used to cover all definitions. A bikeway provides for bicycle travel.

Bicycle paths and bicycle trials will have a completely separate right-of-way designated exclusively for the use of bicycles. Motorized cycles will not be allowed on these bikeways. Pedestrians may be allowed.

Bicycle Lane, Bicycle Track, Bicycle Route, and Sidewalk—Bikeway, refer to the mixing of bicycles, motorized cycles and pedestrians. This is considered as on the road bikeway. The right-of-way is visually designated by signing. The right-of-way may be restricted or shared.

Design Speed

The narrow-tread, lightweight bicycle has a capability of traveling at high speeds, especially going downhill. Most bicyclists travel at a speed between 5 and 25 miles per hour. A design speed of 15 miles per hour is desirable. Bicycle paths and trails are designed for two purposes—recreation, and transportation from one point to another. In both cases standards must be maintained for the purpose of safety.

Capacity

The estimated capacity for a two-way bikeway is very high. Two-way bikeways containing one lane in each direction would have a carrying capacity of over 1,000 bicycles per hour. The type of bikeway, whether used for recreation or for transportation from one point to another, would have some effect on the carrying capacity. It is doubtful that even a recreational bikeway would reach a maximum carrying capacity within the near future.

Grade

If the average grade over a long section is over 10 percent, do not plan a bikeway. The overall grade of an entire bikeway should not exceed 2 percent. Short grades of less than 1 mile at a 10 percent grade are allowable. At the top of any grade that requires a lot of energy for an average cyclist to cycle, a 3- or 4-foot wide pulloff should be constructed.

The radius of curvature should also be considered during the design process. The size of the radius will increase with speed. The formula used for determing the proper radius of curvature—

$R = 1.25V + 1.4$

R = The radius of curvature (ft.)

V = The velocity in m.p.h.

If a bicycle was going 10 m. p. h. the desirable radius of curvature should exceed 13.9 feet.

Facilities

When a bikeway is established, parking facilities should be provided. Adequate bicycle parking facilities will reduce the possibility of thefts. In many cities theft of bicycles has become a major activity. In the city of Denver during 1971 there were over 5,-000 bicycles stolen. The yearly average recovery rate was around 50 percent.

Parking facilities should be at appropriate locations with locking devices to discourage both the prankster and professional theft.

The space requirement for parking facilities will depend upon the number of bicycles a park desires at one location. Twelve bicycles equals the same parking space requirements as one average sized automobile. There are many designs of bicycle racks. The most successful design of a bicycle rack would allow both wheels and frame of a bicycle to be locked securely with a heavy chain. The chain should be rubber-coated. The Denver Bikeway Plan gives the following information on bike racks:

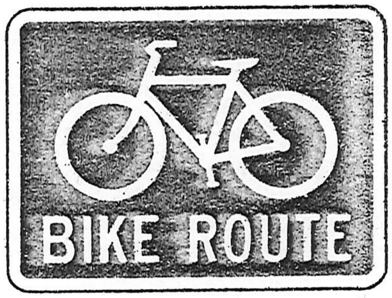
> A high security bike rack has the following characteristics: (1) a chain or cable is permanently welded to the rack; (2) construction is of a heavy gauge material; (3) both wheels and the frame are securely locked to the rack; and (4) the rack is located in low activity areas (low pedestrian traffic around rack all day). A low security bike rack has the following characteristics: (1) no chain or cable is premanently attached to the rack (the bicyclist carries his own chain or cable and padlock(; (2) the rack is placed in high activity areas (high pedestrian traffic around rack all day); and (3) only the front wheel and the frame can be locked to the rack. Some of the types of racks are V-Bar, Radial, Standard and Tree Guard.

Signing

Bicycle signs that are used on the highway shall be standard in compliance with the Manual on Uniform Traffic Control Devices by the U. S. Department of Transportation, 1971 edition. The two types of bicycle signs used are:

Bicycle Route Sign

A guide for marking an officially designated bicycle trail shall be a 24 inch by 18 inch sign with a white legend consisting of a bicycle symbol, the word BIKE ROUTE, and a border in white on a green background. This sign is intended to guide cyclists on a predetermined bicycle route that may be a trail, secondary road, or a combination of safe and suitable surfaces.



When needed, a supplementary sign with a directional arrow may be placed below the BIKE ROUTE sign. The supplementary plate shall be 24 inches by 6 inches with a white arrow and border on a green background.

Bicycle Crossing Sign

The Bicycle Crossing sign is intended for use in advance of a point where an officially designated bicycle trail crosses a roadway.

The signs to be used on a bicycle trail or path may be based on an individual situation. If a park wishes to use the same type of Bike Route sign as used on the highway this is permissable. A bicycle path or trail may be interpretive; therefore, any appropriate signing method may be used.

If a bicycle path or trail is not to be interpreted it is recommended that the signing system comply with the National Park Service sign system specifications. When desirable to use a legend to guide visitors while on the bike trail, the oversized symbol sign plant is excellent.

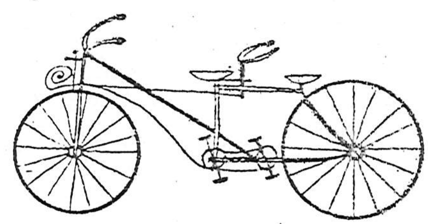
The legend may carry a direction arrow in eight positions, feet or mileage distance, abbreviations, e. g., 3 mi., indication of the beginning or end of a trail, e. g., start, head, end, or be numbered in sequence to indicate progression on a trail, or (a number or name of a trail bearing that number or name) to indicate the trail being followed. Oversize symbol plates in the 18" or 12" category may use the 8" or 6" symbols respectively in place of text.

Safety

All uniformed personnel should be schooled in bicycle safety. There are numerous bicycle accidents each year that should be prevented. The number of bicycle accidents in the United States last year that required emergency room treatment was over one million. The estimated number of people killed while riding a bicycle was around 850.

Many states have inadequate rules and regulations concerning the bicycle. Some states have left the traffic laws regulating the operation of bicycles up to the towns, cities and local municipalities. The laws pertaining to the bicycle in some states were passed years ago when the bicycle was considered a toy and an automobile doing 25 miles an hour was going like a "bat out of hell." The bicycle is a vehicle. Bike drivers should be subject to the same traffic laws as automobile drivers. In national parks there will be no distinction between automobiles and bicycle violators.

Safety rules tell bicycle riders what they should do. Traffic laws tell them what they must do.



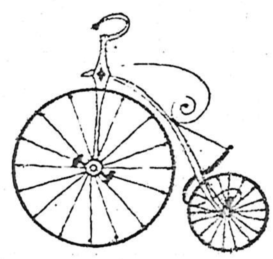
General

- A bicycle is clean, efficient and economical and would be excellent to use between facilities that are more than 5 miles apart.
- All bikeways should be a minimum of three-fourths of a mile and the maximum length as long as feasible.
- Bicycle licensing will not be required on paths or trails. If a state, county or city has jurisdiction over a highway through the park, licensing will be the responsibility of that authority.
- Motorcycles will not be allowed on bicycle paths or trails. The motor creates a noise disturbance and unsafe conditions would prevail.

AVERAGE CONSTRUCTION COSTS

5,280 ft. long x 10 ft. wide
52,800 S. F. = 5,900 S. Y.

a. Clear and Grub - 2 acres	$4,000
b. Excavation (6" average) - 1,000 C. Y.	2,000
c. Grading - 5,900 S. Y.	6,000
d. Aggregate Base (4")- 5,000 S. Y.	9,000
e. Asphalt Surface (2") - 5,900 S. Y.	15,000
f. Drain Pipe (12") - 300 L. F.	4,000
g. Drainage Ditch - 1,400 L. F. (not paved)	4,000
h. Topsoil and Seed-1,800 S. Y.	3,000
i. Signs	500
	$47,500



REFERENCES

1. Haldon L. Smith. *"Ann Arbor Bicycle Path Study,"* Ann Arbor, Michigan, (July 1972)
2. Julian Rinehart. "The Bicycles are Hers." *The Balance*, Department of Interior, Bureau of Outdoor Recreation, Denver, Colorado, November 1971. 8p.
3. American Institute of Park Executives, Inc., *Bike Trails and Facilities: A Guide to Their Design, Construction, and Operation,* Walter L. Cook. Published by The Bicycle Institute of America. (no date) 52p.
4. Bicycle Institute of America, *Boom in Bikeways,* New York, New York, Vol. 6 #2, 1971.
5. Bicycle Institute of America, *Boom in Bikeways,* New York, New York, Vol. 7 #3, 1972. 9p.
6. Bicycle Institute of America, *Boom in Bikeways,* New York, New York, Vol. 7 #4. 8p.
7. State of California Department of Public Works, Division of Highways, *Bikeway Planning Criteria and Guidelines.* April 1972. 175p.
8. Oregon State Highway Division, *Footpaths and Bike Route Standards and Guidelines,* January 1972. 35p.
9. Illinois Secretary of State, *Illinois Bicycle Rules of the Road.* (No date) 80p.
10. Bicycle Institute of America, *Pedal Primer,* New York, New York.
11. City and County of Denver, *The Bikeway Plan.* October 1972. 66p.
12. Vincent R. Desimone, *Planning Criteria for Bikeways,* presented at the Metropolitan Association of Urban Designers and Environmental Planners, San Francisco, California, December 13-15, 1972.

BICYCLE TRAIL

CONSTRUCTION &

PROBLEM AREAS

INFORMATION

William Gaines

TARGET DATES

Monies were allocated for loop "A" in 1977 and for all purposes of the budget should have been completed within that fiscal year. In 1978, similar factors caused the delay of restarting and completion of the trail. However, problems arose where staff were minimal and the allocation for this project were depleted.

These will be discussed in the section entitled Problem Areas.

LABOUR

The approximate labour cost was $8000. spread over a one year period. (Fall of 1977 to Fall of 1978.) The number of workers did not exceed (5) at any time. The trail was inspected periodically by the trail co-ordinator as to problem areas and re-ordering of depleted materials. Initially, the surveyor was on site of construction while actual trail layout was being carried out. Once the intial trail layout was completed, he periodically inspected the trail as to proper depths of material and widths of the trail.

MATERIALS

The materials used in the constructionof the bicycle trail (over -1 year period) included:

Material	Tons	Cost
Granular B	3314	$ 8901.00
Limestone Screenings	1400	4406.00
Limestone 2" clear	70	161.00
Limestone 1" clear	15	34.50
5/8" Crusher run	25	89.70
Cement	6 bags	21.84
Culverts	6	149.76
		$13763.80

The total cost for materials was $13,763.80

The granular "B" material was utilized as subbase for the surface material of limestone screenings. Low areas and sections where culverts were to be installed had, 2" clear limestone to raise the trail height to specific grades as per plans. This material was used with the 1" clear limestone to hold the culverts in place. The 5/8" crusher run material was utilized in holding smaller culverts; (ABS pipe) in place.

AUTOMOTIVE AND EQUIPMENT EXPENSES

Automotive and Equipment expenses totalled $744.60. Equipment utilized in the construction of trail included:

- 1 agricultural field roller
- 1 JD450C Bulldozer
- 1 JD920 Tractor with auger
- 1 JD Backhoe/Frontend loader
- 1 JD 301A tractor w/yorkrake, harrows, blade
- 1 tilt- dump wagon
- 1 Ford 3T dump truck
- 1 Chev 3T dump truck
- hand tools- shovels- rakes, chains

SIGNAGE:

The signs needed to complete the construction of the trail included:

- 6 stop signs
- 10 bicycle symbols
- 10 Directional arrows
- 2 caution-sharp curve
- 2 caution-sharp cyclists
- 22 4"x4"x8' cedar posts

The posts were strategically located along the trail to allow adequate vision of the signs for two-way directional flow. The cost of the signs came to an approximate total $375.00

MULTI-PURPOSE:

The bicycle trail will also act as a pedestrian trail in the summer and provide marked trails, two-way directional flow cross-country ski trails in the winter. The winter cross-country ski trail is approximately 1½ miles in length and will provide numerous link-ups with other cross-country ski trails in the park.

PROBLEM AREAS:

1. Certain factors caused the delay of restarting and completion of the bike trail construction. These include a heavy spring workload in 1978, with all equipment (tractors, ½ ton trucks, trailers) and manpower being utilized for other park maintenance purposes, such as spring spraying programmes and grass maintenance. Hence, manpower and machinery was not available until mid-way through the summer.

2. Drainage problems will no doubt occur, although not on all portions of the trail. Specifically, the section directly behind the toboggan hill, collects all the downward drainage from the hill, and at times in the early fall, water lay about this area to the depths of 1-1½ feet.

PROBLEM AREAS continued

The trail was above the water level, however, culverts were plugged and the water had nowhere to drain.

At the time, the toboggan hill had not yet been completed with drainage ditches located in the bottom land areas around the hill. These will hopefully alleviate accumulations of water in this portion of the trail.

3. The surface of the trail is composed of 2" of limestone screenings which has been compacted. One problem in this area is that with rains, frost, dew and any other types of moisture will tend to loosen up the surface material and wash it away into the ditches.

   The spring run off will provide us with quite a lot of information as to low areas of the trail. Once this has been channelled off the trail or evaporates, extension compaction will have to take place over the entire trail. The best method for this is to utilize the vibrator-compactor-units which you drive. Trail width would not hamper a unit, such as this in compaction of the surface material.

   A second compaction may have to take place after the heavy summer season, before the fall operation begins.

4. At present, the bicycle trail does not link up to the Spruce Lane Farm or Recreation Complex facilities.

   Future loops of the bicycle trail will enable visitors to reach these areas on bicycles.

COST

5280 ft. = 1 mile
7920 ft. = 1½miles

Labour	8,000.00
Materials	14,000.00
Signs	375.00
AE	744.00
	23,119.00

÷ 7920 = 2.919

∴ $2.91/foot

cost/mile - 2.919 x 5280
=$15,412.32

BIKE TRAILS

Preamble

In the past few years bicycling has undergone a tremendous resurgence with increases up to 100% in the numbers of those now riding bicycles, both as a means of transportation and recreation. City Council in September 1970 realized this trend and asked for a joint study by the various Departments involved to produce a report for an overall bike trail system for the City of Calgary. The result of this study was a ten to fifteen year plan called, "A Bicycle Path System for the City of Calgary," 1972.

Trail

Our first stage (built in 1973) was a combination recreational bicycle path and bicycle route from the University of Calgary through Confederation Park and south to Prince's Island.

As Engineering road paving machinery was ten feet wide, this was the width of our trail. Approximately four miles of a total six and one half miles could be considered recreational.

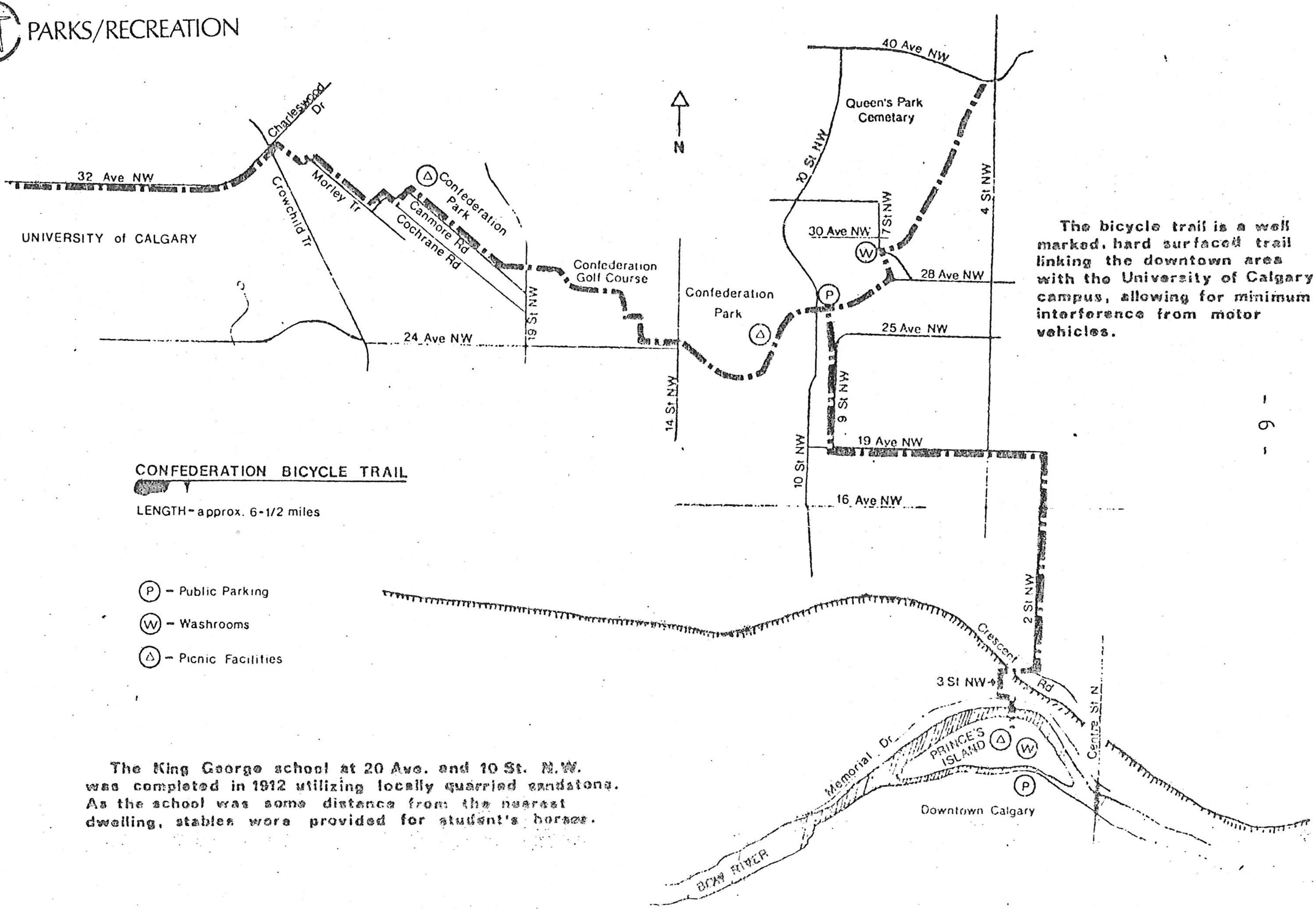
Cost

The total cost for the whole system was estimated at about four and one half million for 165 miles of trails. The first stage, six and one half miles was fairly expensive because of the construction of two underpasses under major roads, but for a continuity of system it was worth the price.

Retrospect

Asphalt has been the ideal material for use but it is costly and difficult to put through natural terrain without extensive damage to the surroundings. The other surfacing we have used at about one half the cost is a gravel base with a one to three inch overlay of red shale. This type of surfacing is easier for joggers and more asthetically appealing in our natural park areas. Maintenance may be a drawback.

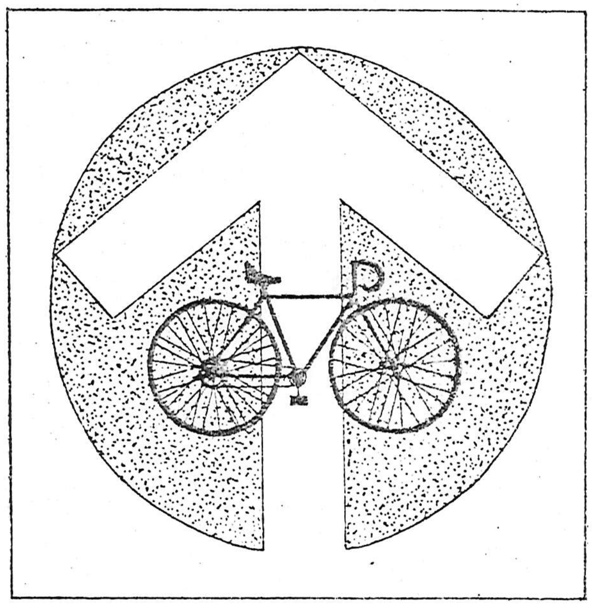
We had originally looked at biking as primarily a recreational pursuit but recent changes in the role of the automobile, environmental pollution, energy wastage and physical fitness trends have caused us to look more at cycle paths as a means of transportation rather than solely recreational.

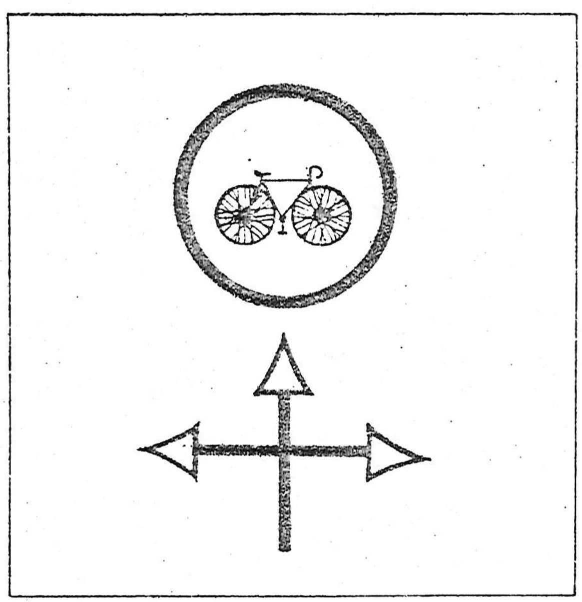


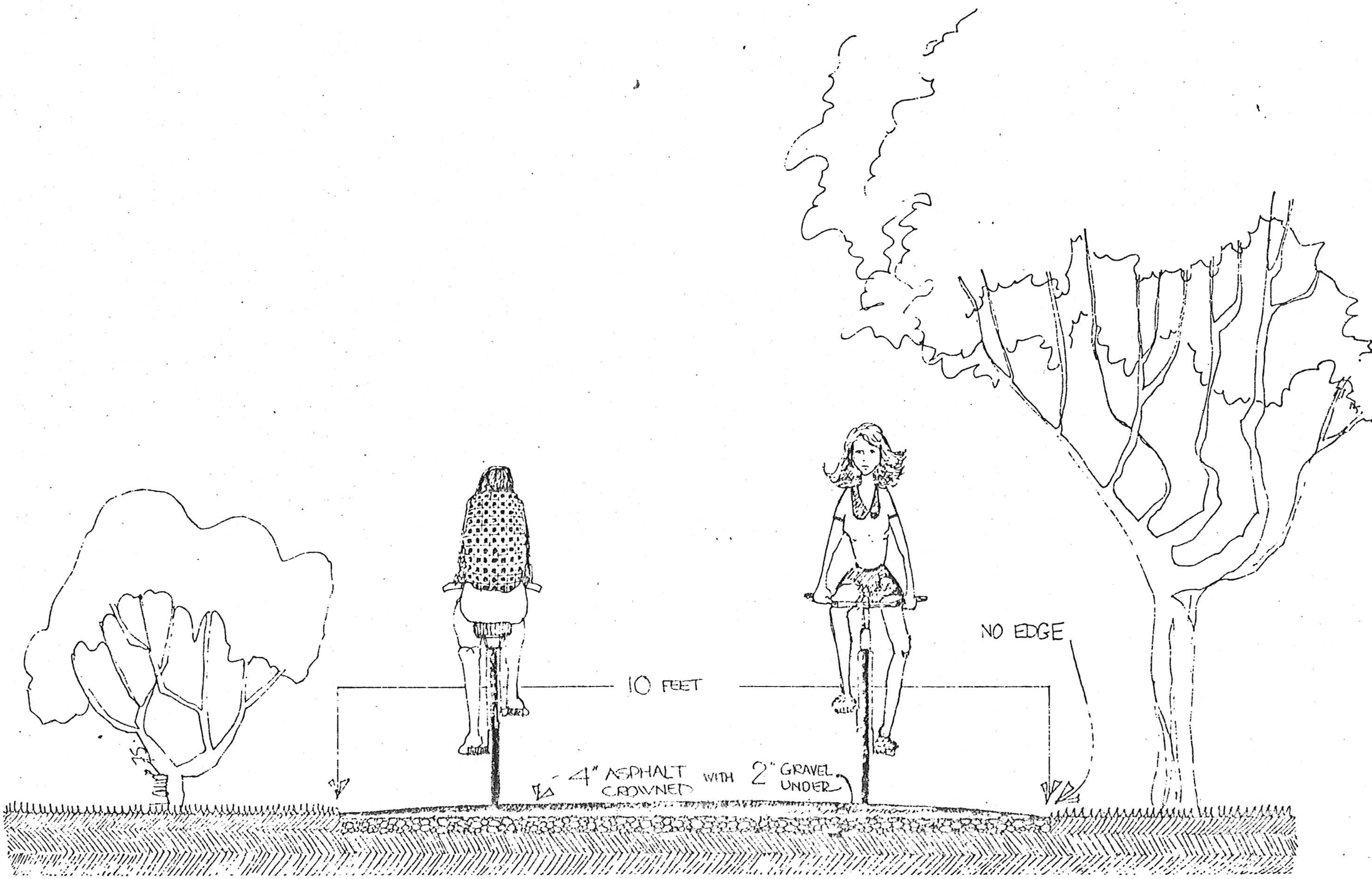
The bicycle trail is a well marked, hard surfaced trail linking the downtown area with the University of Calgary campus, allowing for minimum interference from motor vehicles.

The King George school at 20 Ave. and 10 St. N.W. was completed in 1912 utilizing locally quarried sandstone. As the school was some distance from the nearest dwelling, stables were provided for student's horses.

Bicycle Paths Signs






10 FEET
4" ASPHALT CROWNED WITH 2" GRAVEL UNDER
NO EDGE

Basic Data Brief

BICYCLE PATH DATA

The following data is abstracted from a paper written early in 1973 by Lennon W. Hooper, Jr., Office of Consultative Services, Denver Service Center, National Park Service.

There are around 75-80 million Americans enjoying biking. It has become the nation's most popular outdoor participation sport. The U.S. Department of Transportation is encouraging the use of bicycles as an alternative form of transportation. Organized bike clubs are forming throughout the country. At present there are over a thousand such clubs.

Many states are recognizing the bicycle as another mode of transportation and are planning and constructing for them. Several states are considering legislation which would not only require bicycle trails, but would also authorize the funding for construction. The State of Oregon in one state that has a "Bicycle Bill". This bill, passed June 1971, provides that not less than one percent of the funds received from the State Highway Fund shall be expended each fiscal year for the establishment and maintenance of footpaths and bicycle trails.

(Since Mr. Hooper's paper was written, Congress passed and the President signed the Federal Highway Act of 1973, alloting $120,000,000 for bikeways over a three year period, and the Governor of California has signed SB 821 which can provide up to $3.2 million yearly for bicycle and pedestrian facilities.)

Capacity

The estimated capacity for a two-way bikeway is very high. A bikeway with one lane in each direction has a capacity for over 1,000 bicycles per hour.

Grade

If the average grade over a long section is over 10%, don't plan a bikeway. The overall grade of an entire bikeway should not exceed 2%. (The average drop of the river at Cedar Grove is just under 2%.)

Design Speed

A design speed of 15 miles per hour is desirable.

Facilities

When a bikeway is established, parking facilities should be provided. Adequate bicycle parking facilities will reduce the possibility of thefts. Parking facilities should be at the appropriate locations with adequate locking devices.

Twelve bicycles equals the same parking space requirements as one average-sized automobile.

Signing

Complete signing is necessary to designate the bike route and to provide direction and safety.

Construction Costs

5,280 ft. long x 10 ft. wide

52,800 S.F. = 5,900 S.Y.

a.	Clear and Grub - 2 acres	$ 4,000
b.	Excavation (6" average) - 1,000 C.Y.	2,000
c.	Grading - 5,900 S.Y.	6,000
d.	Aggregate Base (4" - 5,000 S.Y.)	9,000
e.	Asphalt Surface (2") - 5,900 S.Y.	15,000
f.	Drain Pipe (12") - 300 L.F.	4,000
g.	Drainage Ditch - 1,400 L.F. (not paved)	4,000
h.	Topsoil and Seed - 1,800 S.Y.	3,000
i.	Signs	500
	TOTAL	$47,500

Dimensions

Two-way bike path

Width - 8', 5.25' minimum

Clearance - 8' vertical, 1' each side

Materials

Must be smooth hard surface. Recommended - 2" bituminous paving, 4" crushed stone base course, compacted.

Other Design Considerations - (from various sources)

Length - 2.5 miles minimum 5.65 miles average

Bike lanes along roadway (not recommended)

Minimum: 7.5' wide bike lane (2-way)

2 - 10' automobile lanes

27.5' total width

Safer, but still dangerous

8' wide bikeway

1' barrier curb separator

2 - 11' driving lanes

31' Total Width

Maintenance - bike paths should be wide enough and strong enough to accommodate maintenance vehicles.

BIBLIOGRAPHY

Gray, John O., Planning for Bicycles in Berkeley, distributed by Bicycle Institute of America, Inc., Berkeley, California, September 28, 1971.

Hansen, Robert J., Department of Public Works, Portland, Oregon; Preliminary Study of Bicycle Facilities for the City of Portland; Portland, Oregon; October 29, 1971.

Hayes, James J., Editor; Boom in Bikeways, the Newsletter of the Bikeways Explosion; Volume 8, Number 2; New York, N.Y.; October, 1973.

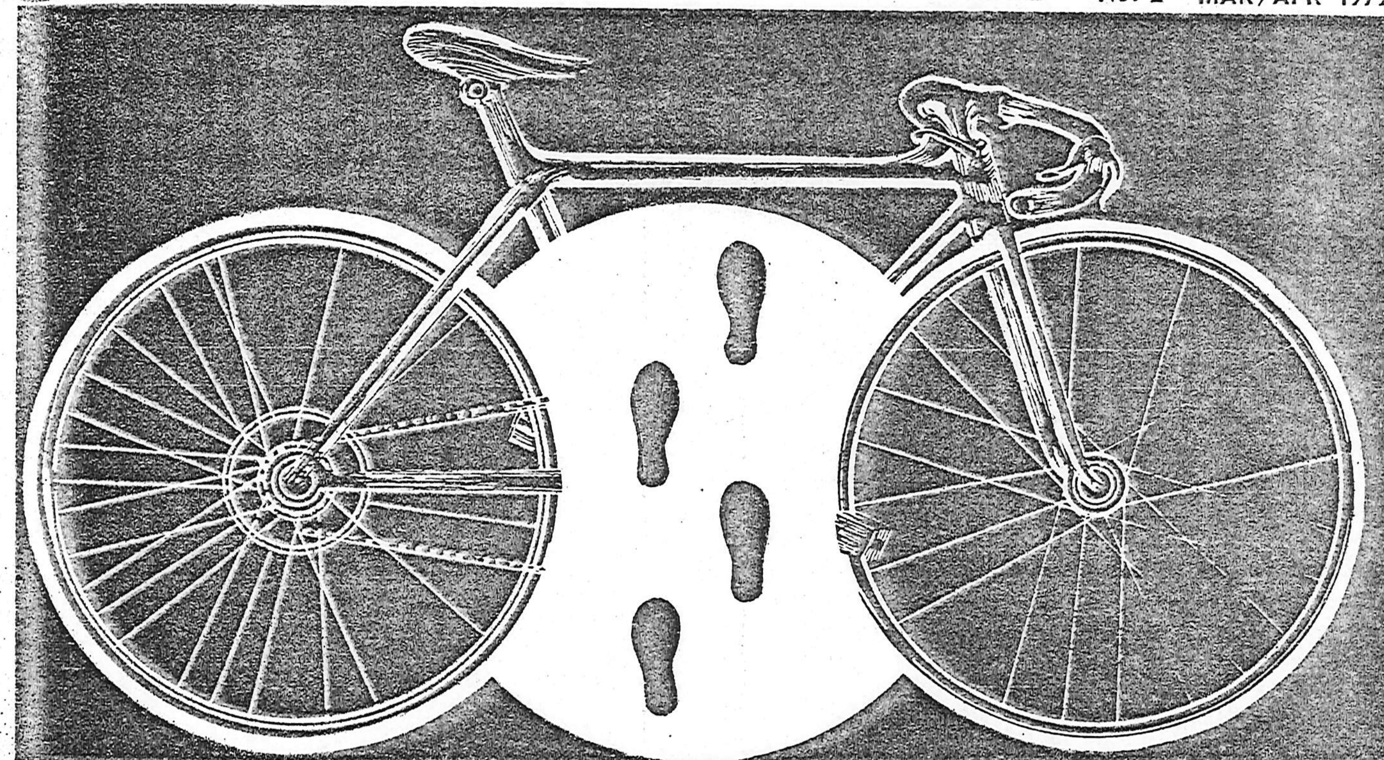
Hooper, Lennon W.; "Pedestrian/Bicycle Planning and Design"; Report to Director, Denver Service Center, National Park Service; Denver, Colorado; February 1, 1973.

Institute of Transportation and Traffic Engineering, School of Engineering and Applied Science, University of California, Los Angeles; Bikeway Planning Criteria and Guidelines; Los Angeles, California; April, 1972.

Nagushi, Joseph; Evaluation of a Bicycle System, for the City of Palo Alto; Palo Alto, California. 1972(?).

guideline

VOL. 2 No. 2 MAR/APR 1972



footpaths & bike routes

This article was prepared by the Oregon State Highway Division in January 1972. It is intended to provide general considerations and methods for bicycle trail and footpath planning, design and construction. The standards and guidelines will vary according to local conditions and special situations.

In the 1971 Regular Session of the Oregon Legislative Assembly, House Bill 1700, commonly known as the Bicycle Bill, was passed which became Chapter 376 of Oregon Laws of 1971. This law provides that not less than 1% of the funds received by the Commission or by any city or county from the State Highway Fund shall be expended as necessary for the establishment of footpaths and bicycle trails.

Such footpaths and bicycle trails provide opportunities to complement present modes of transportation by linking communities, schools, parks and places of work while reducing congestion in areas and conflicts between various forms of travel occurring on some streets and highways. Bicycle and pedestrian pathway establishment creates additional commuting and recreation opportunities within urban, suburban, and rural areas.

(Continued on page 11)

Establishing a plan

I. DETERMINING CYCLING NEEDS, INTERESTS, PROBLEMS

A. Evaluate cycling activity in the community

1. Consult with law enforcement agencies for auto-bike conflicts and problems
2. Interview school officials and school safety committees for determining cycling patterns in the community
3. Consult with local planning commissions and personnel
4. Request opinions from civic organizations and service clubs
5. Request input from cycling clubs in the community
6. Consult authorities in other communities and states
7. Review state and local outdoor recreation plans

B. The survey should determine

1. Individual and group interests in cycling
2. Number and ages of cyclists in neighborhoods
3. Cycling patterns - existing
4. Traffic problems with cyclists using streets
5. Existing laws and ordinances affecting cyclists
6. Community-wide distribution
7. Traffic counts
8. Plans for future developments that may include cycling facilities

C. Available facilities and how used for bicycling

1. Inventory park and recreation areas
   a. Roads
   b. Walks
   c. Hiking trails
   d. Paved multiple-use areas
   e. Parking lots

2. Community facilities not under park and recreation department that have potential for cycling
   a. Side streets
   b. Secondary and little-used roads
   c. School grounds
   d. School and college tracks
   e. Fairgrounds
   f. Parking lots
   g. Utility rights of way

3. Facilities that can be converted, expanded, or improved for bicycling
   a. Dry canals
   b. Dry riverbeds
   c. Abandoned railroad beds
   d. Existing little-used pedestrian or riding paths and trails

D. Evaluate

1. In terms of facilities
2. In terms of facilities for bicycling

II. EXISTING FACILITIES

A. Evaluate planned bicycle programs in light of community survey to determine need for expansion

B. Experiment with marking roads and streets as bike routes

C. Experiment using walks, hiking trails, etc., signed and marked as bike routes.

D. Try multiple uses of facilities

E. Evaluate use to determine additional need

III. CONSTRUCTION OF NEW BIKE ROUTE FACILITIES

A. Check for suitability

1. Topography
2. Scenic qualities
3. Points of interest
4. Passing other activity points
5. Proximity to service facilities
6. Consider using perimeter areas
7. Consider following canal, creek or riverbanks
8. Consider paralleling roads
9. Compatibility with overall plan or ultimate goal

B. Plan layout

1. Sketch approximate route
2. Possible additional engineering necessary (topography, etc.) for detailed layout
3. Design variety into trail to insure repeat use
4. Determine length of trail - avoid a short facility
5. Determine width of trail
6. Consider maintenance
7. Consider lighting
8. Consider street crossings and alternatives
9. Plan markings and signs

IV. EXPLORE POSSIBILITIES OF FEDERAL HELP

A. Land and Water Conservation Fund Act

B. Economic Opportunity Act

C. Open Space Program

D. Urban Renewal

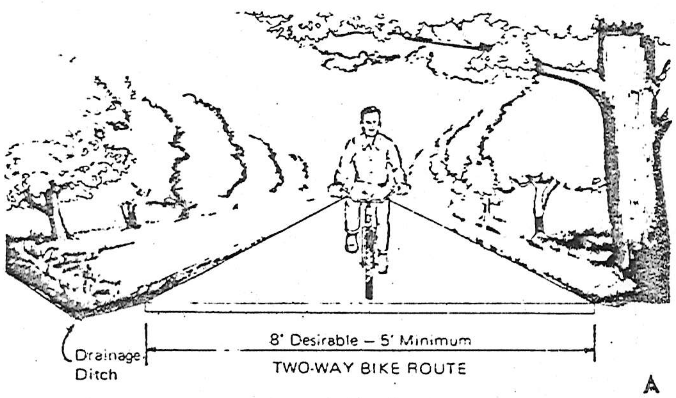
E. Federal Highway Act

Planning and design

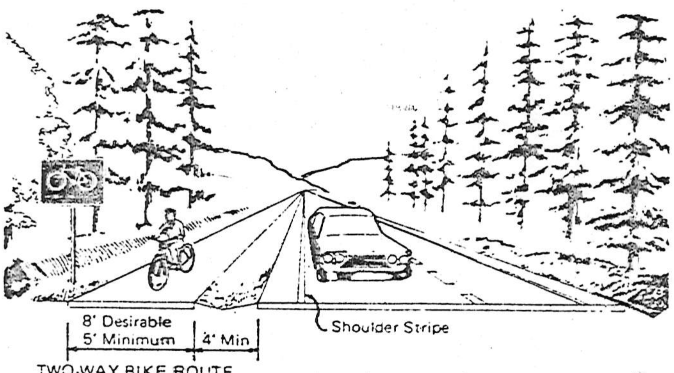
I. GENERAL CONSIDERATIONS FOR DESIGN AND CONSTRUCTION OF FOOTPATHS AND BIKE ROUTES

A. Four types of bike routes for varying conditions.

1. An independent trail for exclusive bicycle/pedestrian use that may be entirely independent of other facilities (A) or utilize highway right-of-way (B)

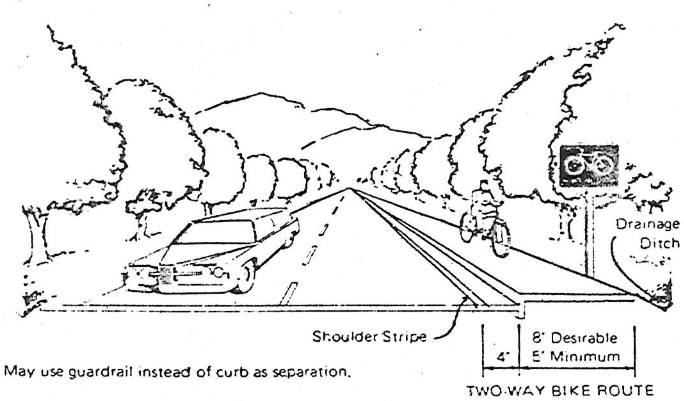


A

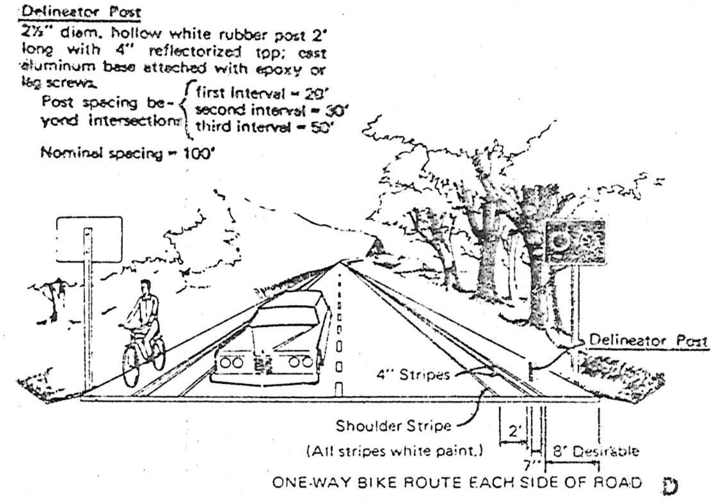


B

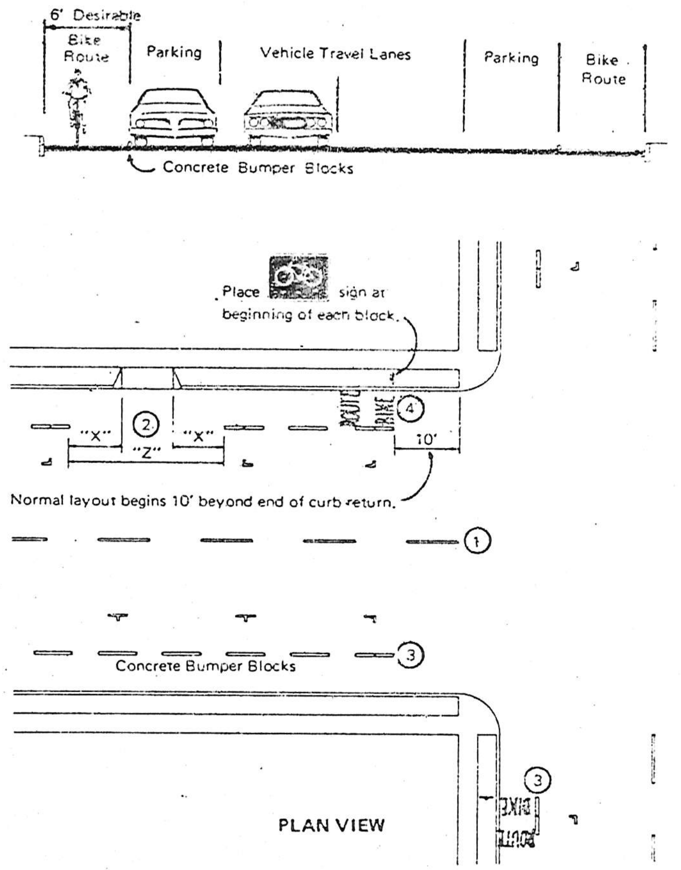
2. A bike route that utilizes city streets, secondary roads and other existing facilities and is so designated by signs, striped lanes, and/or physical barriers such as guard rail, special fencing, curbed sections, etc. (C, D, E, F)



C



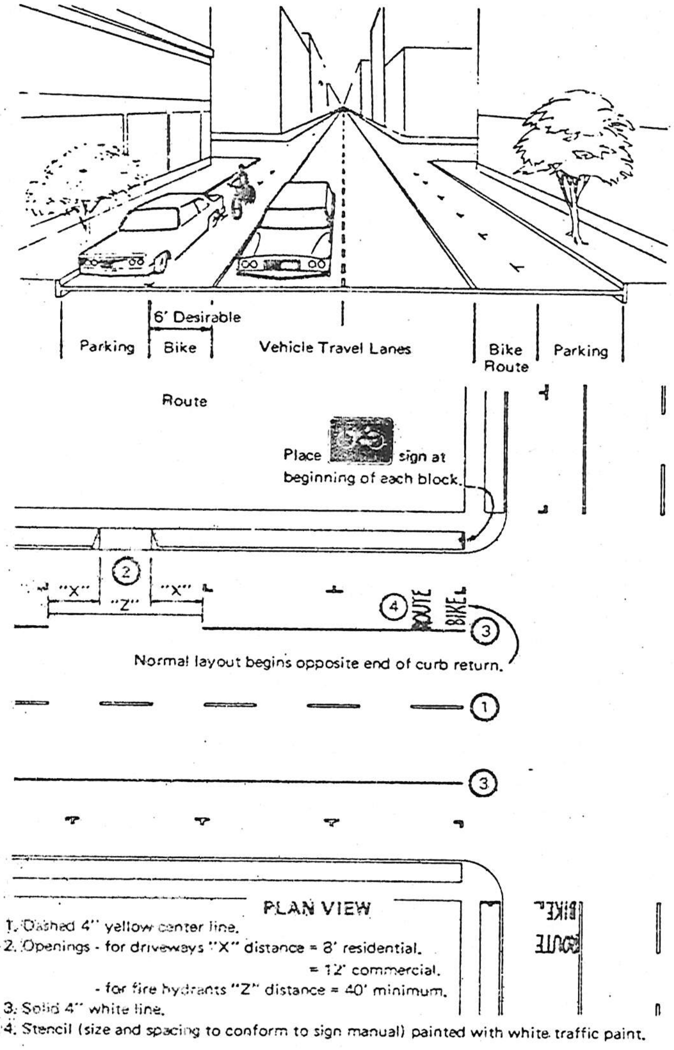
D



1. Dashed 4" yellow center line.
2. Openings - for driveways "X" distance = 8' for residential.
   = 12' for commercial.
   - for fire hydrants "Z" distance = 40' minimum (place 3" white stripe in this section).
3. At the beginning and end of each block and at all openings paint ½ bumper block yellow and install reflective marker on end of bumper block.
4. Stencil (size and spacing to conform to sign manual) painted with white traffic paint.

ONE-WAY BIKE ROUTE EACH SIDE OF STREET

E

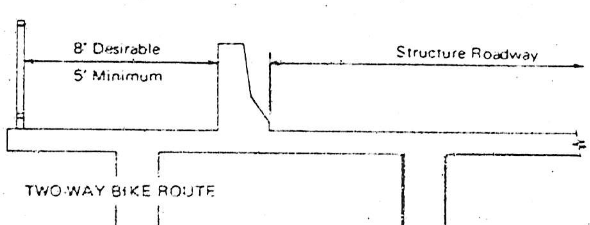


ONE-WAY BIKE ROUTE EACH SIDE OF STREET

F

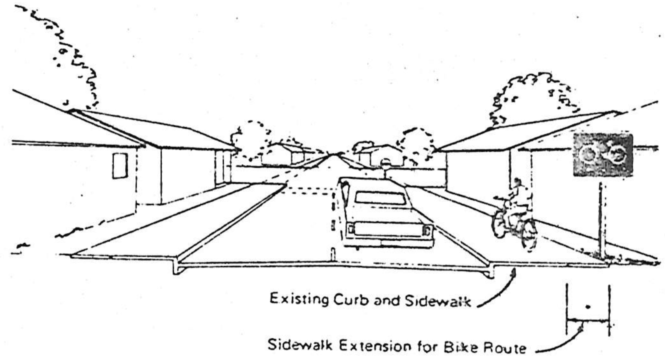
3. A bike route utilizing same as above, but is signed only. No provisions are made for separation.

4. A bike route to be constructed as part of a new structure, signed and separated from the travel way by a physical barrier (G)



G

5. Extra width on sidewalks, usually 2' to 3' with markings or signing to allow bicycle traffic (H)



*2' to 3' (4' to 5' where poles or mailboxes are located in sidewalk).

ONE-WAY BIKE ROUTE EACH SIDE OF STREET

H

Photo by U.S. Bureau of Outdoor Recreation

Cyclists ride along tree-lined trails in Golden Gate Park, San Francisco, California.

B. Features of interest

A footpath and bike route, while providing a means for reaching one point from another, should provide stops and access to and near parks, viewpoints, or items of cultural interest. It should allow riding through a diverse and dynamic landscape. The following lists some of the items to be considered in route selection:

Physical Features

a. Terrain
b. Vegetative cover, open areas, deep woods
c. Lakes, streams, ponds, rivers, waterfalls
d. Geologic formations
e. Highways
f. Canals, Utilities
g. Railroads

Cultural Features

a. Historic sites
b. Rest areas
c. Shopping centers
d. Bridges
e. Parks
f. Civic centers
g. School campuses

If a route cannot pass close to or through some items of interest, spurs or connecting loops may be considered as additions to the main trail to create diversity and stimulate interest.

C. Length of facility

Generally speaking, the proposal should be in excess of five miles in length to assure continued interest and utilization by the pedestrian and bicyclist. If the proposal serves largely commuting traffic, and if large sources or generators of use (e.g., college campus, large factory) are present at the termini, short distance and direct routes may become a primary consideration.

Ideally, a bike route should serve a commuting and overall transportation use with segments or all of that trail being used for recreation purposes.

Other proposals may specifically serve the racing and competition bicyclists.

D. Width considerations

The recommended width for bike routes is eight feet, but heavily used, urban bike routes can exceed this width. For a two-way bike facility, the minimum width is five feet. Where conditions warrant one-way trails, sections with widths of three to four feet would be considered adequate, but minimal.

If the bike route is to be established in conjunction with sidewalks, it is desirable to add extra width to accommodate bicycles—a minimum of two feet to four feet is recommended, generally extending the total width of the sidewalk to seven to nine feet.

E. Bridges

Bridges will need to be wider than the bike routes they connect, particularly if two-way traffic is to be accommodated. A survey shows that an average width of bicycle bridges is 7.5 feet, therefore a basic minimum of 8 feet is desirable.

Consideration should be given to pull-off areas either on or abutting the bridge to take advantage of scenery or other interesting features of the crossing.

F. Horizontal and vertical alignment

Development of the horizontal alignment, in many respects, is similar to that of highway, roads or streets. Where the bike route is contiguous with such existing facilities, it assumes the same alignment with deviations to create interest—the extent of deviation would be dependent upon topography, culture, and available right of way. When the facility is not contiguous to an existing roadway, it is not necessary to employ transition (spiral) curves. It is important to recognize that trails not contiguous to a road or street are not bound by the alignment of the road or street and freedom in alignment is allowed under these conditions. The bike route in this instance can follow the topography prevalent in the area keeping cuts and fills to such a minimum to ensure proper drainage of the trail. It may be desirable to split the trail creating a "one-way" condition to avoid trees or other obstacles—this also adds interest to the trail. Curve radius should be selected to provide a smooth transition in the change of direction. In some instances where the angle between adjacent tangents is slight (10° or less), curves are not necessary. Short, sharp curves and sharp angles should be avoided if possible, particularly in areas where high speeds can be attained, e.g., at the bottom of a long descending grade. Opportunities should be given to permit the cyclist to slow down and not brake while in the curve.

A bicycle is a versatile machine and is capable of negotiating a 6-foot radius; the range of minimum turning radii reported in a recent survey varied from 6 to 50 feet with an average minimum radius of 17.4 feet. On this basis, the minimum turning radius should be 20 feet.

Grades should vary on a bike route, particularly one serving recreation cyclists. The main condition to avoid is long, steep uphill grades. A 15% uphill grade for short distances may be considered a working maximum, while 10% grade is a desirable maximum. The grade and its length must be judged together. The long climb, even though gradual, should be avoided.

G. Land acquisition

There are five methods of acquiring land or arranging for its use in the development of trails:
a. Purchase of title in fee simple
b. Lease arrangements
c. Purchase of easements
d. Gifts or dedications
e. Zoning

Fee simple acquisition is generally the most expensive method, but it guarantees the fullest use of property.

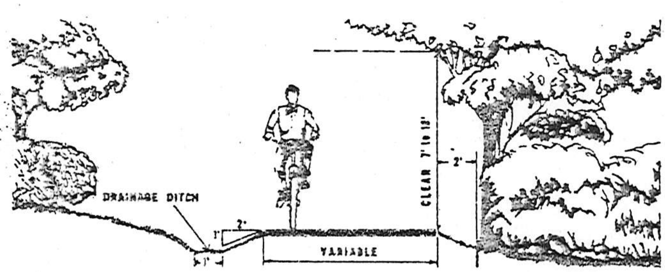
Acquiring lands or rights for bike route use may be complicated by many factors due to the linear aspects of a trail, and several methods of acquisition may be necessary for establishing one facility. Purchase of fee title should be used where major use areas such as rest stops, mini parks, campground or parking areas are anticipated. Less than fee title arrangements can then be made for intervening areas where only bike route use itself is warranted.

Width of right-of-way will vary considerably and, as a minimum, needs only to be as wide as the trail itself. In most cases, this minimum should be surpassed to afford some protection from encroachment. Where scenic qualities, anticipated use and/or physical features warrant, right-of-way may be extended considerably. Generally, 15' could be considered a working minimum.

Construction

A. Clearing

Vegetation should be cleared to a minimum of 2' from the edge of the bike route surfacing. Overhead clearance should be maintained for a 7' minimum and 10' is preferable. All dead branches and trunks should be removed from above the trail. All vegetation, including roots, on the subgrade should be removed down to bare earth.



TYPICAL SECTION SHOWING CLEARING & DRAINAGE

B. Drainage

Drainage should be properly handled to prevent washouts, and to avoid ground saturation beneath the trail. The trail should be sloped to provide runoff, and ditches should be provided where necessary. Underdrains may be necessary in very wet places to prevent frost action with resultant heaving.

In special instances, catch basins and drains may be needed.

C. Bases

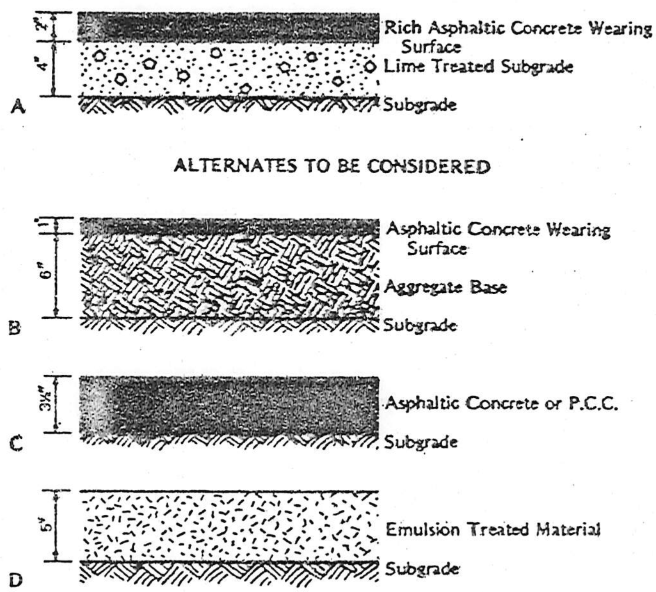
Bases and subbases need to be adequately prepared to protect the surface. Removal of topsoil, stumps and roots and compaction of subgrade will normally be adequate. In wet or otherwise poor conditions, crushed stone or slag may be necessary for stability. General specifications for sidewalks, light-duty roads or driveways will generally be applicable.

In most instances vehicles will be used for maintenance, so the base design will need to be of adequate quality to support maintenance vehicles.

The base course, depending upon locality, methods, etc., may consist of crushed stone, or other appropriate material.

TYPICAL SECTIONS - BASE DESIGN

CONSIDERED AS NORMAL



Bicycle path near Provincetown, Mass., Cape Cod National Seashore.

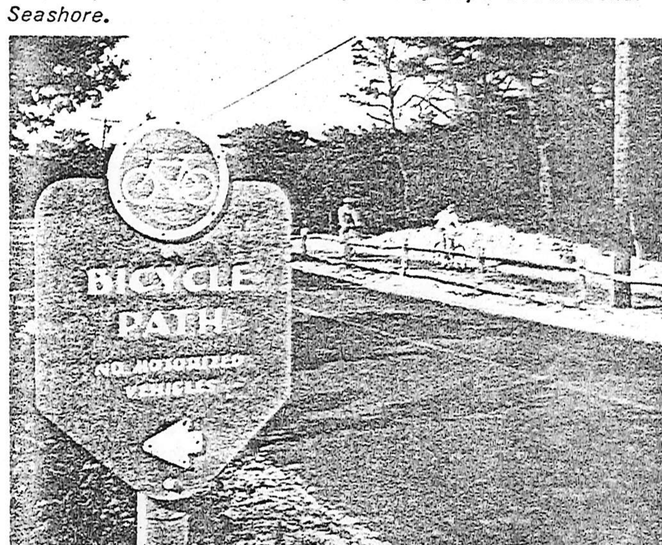


Photo by C. W. Stoughton

Appendix

Standard Signing

All signs and markings must conform to the *MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES*, 1971 edition.

BIKE ROUTE

USE
A nationally-approved sign for marking an officially designated bicycle trail, appropriate both where a trail is separate from a street or highway and where a trail may be routed on selected roads or streets.

MATERIAL
Alloy aluminum or any other suitable metal, plastic or high-density plywood.

FINISH
Reflectorized if to be used at night by bicycles and automobiles, but otherwise not required.

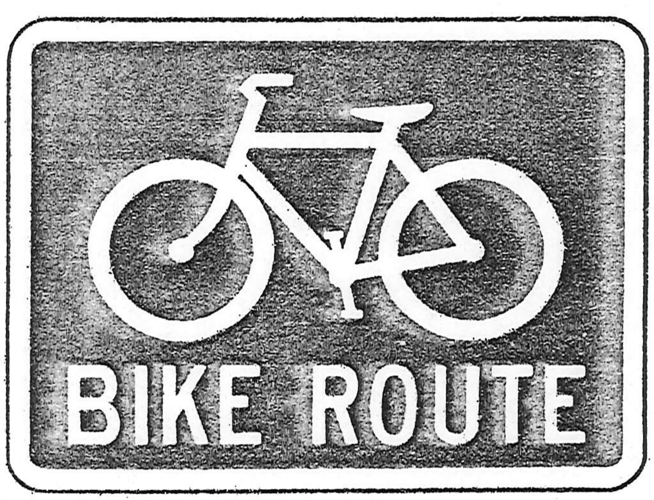
COLORS
Standard Interstate Green, White.

GAUGE OF METAL
Suggested: .064"

DIMENSIONS
24" x 18" mounted as horizontal rectangle.

DESIGN
A bicycle symbol; the words BIKE ROUTE in 3" Series C letters.

CATEGORY
"Guide" or "Trail Blazer".



XING

USE
A nationally approved sign for placement on a street or highway just in advance of a point where an officially designated bicycle trail crosses the roadway.

MATERIAL
Alloy aluminum or any other suitable metal, plastic or high-density plywood.

FINISH
Reflectorized material as in warning signs if it must be effective at night.

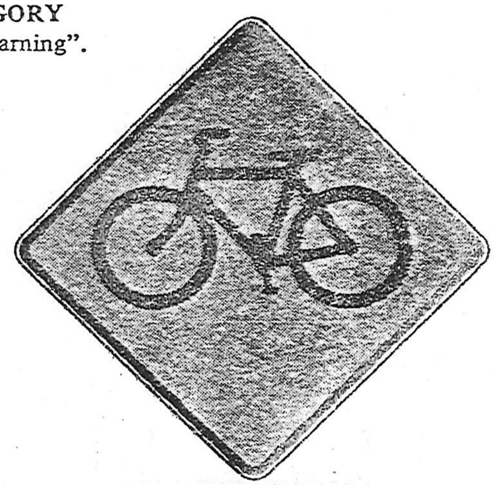
COLORS
Standard Hi-way Warning Yellow, Black.

GAUGE OF METAL
Suggested: .080"

DIMENSIONS
30" x 30" mounted as a diamond.

DESIGN
A bicycle symbol; the term XING in 6" Series D letters. "X" substitutes for "cross", shortening the word "crossing".

CATEGORY
"Warning".



The city has other sources of revenue that it could use for bikeway development. Possibilities include parking revenues, the wheel tax, and local allotments from the State Motor Vehicle Revenues (normally 100% used for highways, but not required).

BIKEWAY COSTS

The cost of bikeway construction varies widely with the type of facility being developed and land through which it passes. Costs for some of the elements of typical bikeways appear on page 24. From these costs the cost of developing bike paths, lanes, and routes are estimated as follows:

(1) Bike Paths. Costs normally include the expense of paving (and preparation), marking, and signing. The variance in cost is primarily influenced by the type and width of pavement. Most signs would probably be on existing posts. Acquisition cost of right-of-way is not included since land values vary widely. Many bike paths may be incorporated into existing highway right-of-ways.

Bike Path Costs	Type and Width of Pavement: Rolled Stone 6' wide	Asphalt 6' wide	Concrete 8' wide
per short block (250')	$ 400	$ 600	$ 1,000
per long block (600')	$ 900	$ 1,300	$ 2,400
per mile (continuous)	$8,000	$12,000	$ 23,000

(2) Bike Lanes. The cost of bike lanes are normally composed of the expenses of signs, pavement markings, and traffic separators. The variance in cost of bike lanes is primarily influenced by the type of traffic separator - painted lines or raised barriers. Signs would probably be on existing posts. The right of way is normally a former traffic or parking lane on an existing street. Some additional cost (not included below) may be incurred to modify auto traffic and parking facilities.

Bike Lane Costs	Type of Traffic Separator: Painted Separator	Asphalt Dike Separator
per short block (250')	$ 70	$ 210
per long block (600')	$ 150	$ 500
per mile (continuous)	$1,300	$4,200

(3) Bike Route. Signing costs are usually the only expense of bike routes. Although separate posts may be used, signs would probably be placed on existing poles. The right of way would be the existing street.

Bike Route Costs	Type of Signing: Signs on Existing Posts	Type of Signing: Signs on New Posts
per short block (250')	$ 16	$ 44
per long block (600')	$ 32	$ 88
per mile (continuous)	$ 80	$ 220

Costs of Bikeway Elements

Item & Source	Short Block	Long Block	Mile
A. PAVEMENT (6) (including preparation)	(250')	(600')	(continuous)
4" Concrete, 6' Wide	$750	$1,800	$15,800
3" Asphalt, 6' Wide	530	1,260	$11,100
3" Rolled Stone, 6' Wide	360	880	$ 7,700
B. BARRIER (8) 6" Asphalt Dike	$175	$ 420	$ 3,700
Dowelled Curb, Type B3 (parking bumper)	$125	$ 300	$ 2,600
C. STREET MODIFICATION (8) Concrete Ramps (including curbcut) 4" depth, 6' wide 2 per block	$ 72	$ 72	N.A.
D. PARKING (7) Standard bike rack	$140 each	N.A.	N.A.
E. MARKING (8) single 4" dashed white lane line	$ 25	$ 55	$ 500
double 4" solid yellow lines	$ 35	$ 80	$ 700
Removal of Painted Stripe	$ 50	$ 120	$ 1,100
F. SIGNING (7)	(2 per block)	(4 per block)	(10 per mile)
Bikeway sign on existing post	16	32	80
installed on wooden post	44	88	220

International City Management Assoc.
Management Info. Service
April 1973, Vol. 5, No. 4
Planning & developm't of bikeway systems

IMPLEMENTATION CHECKLIST

1 Follow a comprehensively planned course of action from the outset. If a local system is to be developed that will optimize opportunities for cycling, a clearly defined action program is mandatory.

2 Make an early and informal study of local cycling goals, needs, and problems. Utilize the knowledge and experience of groups and individuals such as local police, school principals, civic and service clubs, bicycle interest groups, and planning agencies to assess both public demand and political support for the development of a local system.

3 Carry out a detailed analysis of the local demand for cycling facilities through surveys, interviews, observations, and analysis of existing records. Include an analysis of individual and group interest, volume and age of cyclists, cycling patterns, existing conflicts between cyclists and other modes of transport, existing plans for cycling support systems, etc.

4 Survey and inventory existing and potential local facilities. Evaluate the full range of existing local facilities from the standpoint of both current and potential usage. This includes the inventorying of local park and recreation facilities as well as locating other facilities that could be converted for cycling.

5 Motivate community participation. Provide a means by which public interest can be both insured and focused — as the implementation of a local bikeway system demands it. Solicit the support of all groups and individuals that will benefit from, or be affected by, the development of a local bikeway system. Use of a Bicycle Coordinating Committee (BCC), having communitywide representation, to review and coordinate citizen participation is vital to the overall planning process.

6 Develop a preliminary bikeway master plan. Incorporate a set of clearly defined local goals, a statement of the dimensions of the current and projected demand, and the availability of alternative bikeway routes. Detail in the plan the proposed layout of routes, construction specifications, cost projections, and the scheduling of implementation. Publicize and make the master plan available to the public as widely as possible in a understandable format. Solicit the reactions of all affected parties and reevaluate the plan in light of their responses.

7 Initiate implementation of the plan. Explore in detail alternative means of financing development of the local system. Consider the use of federal and state assistance programs, as well as the feasibility of local financing through municipal bonds.

8 Develop a public safety cycling education program. Starting an active bicycle safety program insures ongoing community support of the bikeway concept. The participation of groups such as local police, PTA's, and school officials can significantly enhance public awareness of the safety benefits and transport advantages of bikeways.

9 Develop an ongoing review process. In some localities the process of implementing a bikeway plan will necessarily be long-term. Consequently, there is a substantial need for monitoring and reassessing local demand as a basis for modifying the general plan as local conditions evolve.

ments for establishing the presence of a bicycle path will have to be set forth as soon as legal sanctions such as special use of a road surface or right-of-way privileges are assigned to officially designated bicycle paths. Minimum requirements for the identification of a path will be necessary, just as there now are specific requirements as to the minimum signing needed to establish restrictions on the use of roads and highways (e.g., no parking).

Bikeway Construction Costs. The following cost estimates for construction of bikeways (all types) include all materials and labor. All costs are 1971 figures and should, therefore, be escalated approximately 10-12% per year.

Financing Bikeway Systems. Although bikeway systems demand relatively limited dollar investments, current demands for public resources are of a magnitude that often necessitates outside financial support. Primary sources of these additional dollars are federal matching funds and grants in aid, state highway trust funds, and local municipal bonds.

Federal Programs. The Open Space and Legacy of Parks programs sponsored by the Department of Housing and Urban Development and the Land and Water Conservation Fund of the Bureau of Outdoor Recreation provide matching funds for bicycle ways. First priority for these funds is recreational bikeways. As a result, any city application for funding should stress the recreational aspects of the proposed bikeways. Because the federal government will not fund a single program from two sources, the city must decide which Federal program, HUD or BOR, fits its needs more closely. Factors to consider in making this decision include availability of matching funds, scope of the program, administrative procedures, and timing of a bikeway construction program. Both of these programs reimburse a community for one-half of the

Parkway Bike Lanes

MATERIAL	COST
Signs — two per block	$ 7.50/each
Sign installation	$ 19.50/sign
Paint — intersection cross stripe	$ 13.68/intersct.
Street message	$ 14.00/intersct.
Curb-cut — two per block (estimated for a 5' sidewalk)	$ 968.00/block
Asphalt — 8' strip	$ 2.50/linear ft.
Short block — two signs and installation, 266 ft. of asphalt, two street messages, two curb-cuts, intersection cross stripe	$1,576.00/block
Long block — 600 ft. of asphalt, two signs and installation, two street messages, two curb-cuts, intersection cross stripe	$2,244.00/block

On-Street Bike Lanes

MATERIAL	COST
Signs — 24" x 24" reflective base	$ 7.50/each
Sign installation	$ 14.50/sign
Paint — 5" yellow stripe 8 feet from and parallel to curb	$ 0.025/linear ft.
Cross stripe at intersection 12" x 36', 5 stripes	$ 13.68/intersct.
Street message — two per block	$ 14.00/block
Short block — 266 ft. stripe, two street messages, two signs and installation, 60 ft. cross stripe	$ 82.65/block
Long block — 600 ft. stripe, two street messages, three signs and installation, 60 ft. cross stripe	$ 113.00/block

Sidewalk Bike Lanes

MATERIAL	COST
Signs — two per block	$ 7.50/each
Sign installation	$ 14.50/sign
Paint — intersection cross stripe	$ 13.68/intersct.
Street message	$ 7.00/intersct.
Curb cut — two per block (estimated for a 5' sidewalk)	$ 968.00/block
Sidewalk repair	$ 5.00/linear ft.
Addition to sidewalk width (3')	$ 2.70/linear ft.
Short block — two signs and installation, one street message, two curb cuts, intersection cross stripe	$1,037.00/block
Long block — two signs, one street message, two curb cuts, intersection cross stripe	$1,037.00/block

Gulch Bike Lanes

MATERIAL	COST
Asphalt — 8' wide	$ 2.50/linear ft.
Short block	$ 532.00
Long block	$1,200.00

funds actually spent on the project. Funds returned to the city are eligible for matching with more federal money on a continuing basis. The only stipulation is that the money has to be spent before it is matched.

In contemplating the use of federal funds, it should be recognized that the delays and restrictions inevitably associated with various grant-in-aid programs can seriously delay proposed bikeway systems and exclusive reliance on these funds should be carefully evaluated.

State Programs. The state of Oregon is a prime example of state resource commitments to the financing of bikeway systems. Legislation in Oregon makes it mandatory that a minimum of one percent of state highway funds be allocated to the development of recreational trails.

In that bikeways are an increasingly recognized political issue, it can be anticipated that the incidence of new legislation at the state level will result in additional financial support in the relatively near future.

Local Bond Issues. Implementing the provisions of a bikeway plan in most communities depends on the development of a comprehensive program of financing drawing on several sources of funding. One direct approach to bikeway financing is that of the bond issue — assuming that the magnitude of local public demand for the bikeway system is adequately reflected in a favorable political climate.

In developing the Denver Bikeway Plan one of the primary means of financing involved has been the capital improvements bond program, which asked voters for $400,000 for construction of the general citywide bikeway system. Under this proposal the Denver city council would provide ongoing appropriations designed to implement a comprehensive bikeway system over an extended period of time.

Another possible source of funds for construction is the licensing of bicycles. Two agencies that could perform the licensing function in many communities are parks and recreation and the local license bureau. It is, of course, difficult to estimate accurately potential revenue from this source because of the difficulty of enforcing mandatory registration. However, relating licensing to new bicycles purchased locally should ensure that the user is a contributor to the process of financing adequate and safe facilities.

Demarcation and Signing Techniques. Adequate signing procedures are critical to the planning of safe bikeways of all classes. Currently there is very limited uniformity in signing practices, and a wide variety of symbols are utilized on all classes of bikeways in the United States. Local signing often reflects local traditions and history instead of good safety practices. Signing provides a variety of benefits including be computed in the same manner as for highways. Reference should be made to A Policy On Geometric Design of Rural Highways, 1965, American Association of State Highway Officials, pages 134-140. In general, the sight distance length needed on a particular segment of a facility is dependent on its design speed and profile gradient.

Bridges

Bridge designs and cost estimates may be obtained from the Bridge Design Engineer of the DOT's Division of Highways District Offices, where a bike path is being planned, upon submission of appropriate field data.

CONSTRUCTION AND ELEMENT COSTS FOR BIKE ROUTE TYPES

Bike Path

Construction costs for bike path materials are summarized in Table II-4. An engineer should be employed to estimate final costs since terrain and design dictate cost.

Bicycle Way (Shoulder)

The estimated cost for this facility is $15,700 per mile (September 1974). It should be noted that there will be a substantial reduction in long-term maintenance cost for highways with paved shoulders. The cost estimate computations for this facility are shown in Table II-5.

Structural Section

Designing and constructing the structural section for bike paths is a subject on which a great deal of bike path effectiveness depends. A basic bike path structural section criterion is that the section be adequate to support the wheel loads of bicycles and their drivers as well as maintenance vehicles that may use the facility. If bituminous concrete is used, paving machines usually require 11 feet of horizontal clearance. Discussions on bike path structural sections (subbase, base, and wearing surface) follow.

Subbase

A properly prepared subbase can increase the life of a bike path. In addition to its load carrying function, a subbase must also be capable of providing adequate drainage for the section. A well drained subbase will help to avoid undesirable settlement and frost heave.

The subbase should be constructed, for the most part, of compacted, in-place soil following clearing and grubbing operations. In certain situations where unstable or wet ground conditions exist, stabilization methods will have to be employed. A reasonable material for use in stabilization operations can be selected by examining soil case studies and available financial resources of the area.

Table II - 4

COST AND POTENTIAL OF VARIOUS BIKE PATH MATERIALS

MATERIAL	COST/MILE* 6' wide - 8' wide	MAINTENANCE COST TREAD-UPKEEP	ADVANTAGES	DISADVANTAGES
Portland Cement Concrete (4" concrete on 4" base course)	$19,700 - $26,300 (Includes cost of base course)	Low - Moderate	1) Long service life 2) Supports heavy loads if reinforced 3) All weather surface	1) High construction cost 2) Difficult and costly to maintain
Bituminous Concrete (2" concrete on 4" base course)	$10,500 - $14,100 (Includes cost of base course)	Low	1) Long service life 2) Easy to maintain 3) All weather service 4) Smooth riding surface	1) Moderately high construction cost 2) Requires skilled technicians for good quality
Compacted Aggregate (4" deep)	$2,100 - $2,800	Moderate - High	1) Easy to maintain 2) Low cost	1) Short life expectancy 2) Not an all weather surface 3) Poor riding quality
Soil-Aggregate Mixture (4" deep)	$2,800 - $3,700	High	1) Low cost 2) Easy to maintain	1) Not an all weather surface 2) Cannot support heavy load 3) Poor riding quality
Soil Cement (4" deep)	$6,200 - $8,300	Moderate	1) Smooth riding surface 2) Easy to maintain	1) Susceptible to erosion 2) Erodes easily under traffic
Limestone Screenings (3" deep-in place)	$1,175 - $2,286	Moderate	1) Relatively maintenance free-when less than 4% grade 2) Low cost	1) Becomes soft when frost first begins to leave the ground each spring 2) Dusty when dry

*1974 Dollars

Table II-5

BICYCLE WAY (Shoulder)
COST ESTIMATE PER MILE (September 1974)

Bituminous Concrete Pavement, 2-Inch

(width)* (length) (ton/2"/s.y.) (unit price)

$\frac{16 \text{ ft.} \times 5280 \text{ ft.} \times 0.12 \text{ tons/s.y.} \times \$9.00}{9 \text{ s.f./s.y.***}}$ = $ 10,137

Bituminous Material for Surface Course

(6% bit. mat.) (width) (length) (ton/2"/s.y.) (unit price) = $ 6,758

$\frac{0.06 \times 16 \text{ ft.} \times 5280 \text{ ft.} \times 0.12 \text{ tons/s.y.} \times \$100.00}{9 \text{ s.f./s.y.}}$

** Crushed Aggregate Base Course, 2-Inch

(width) (Length) (depth) (ton/c.y.) (unit price)

$\frac{16 \text{ ft.} \times 5280 \text{ ft.} \times 0.17 \text{ ft.} \times 2 \text{ ton/c.y.} \times \$2.50\text{/ton}}{27 \text{ c.f./c.y.***}}$ = $ 2,659

	$ 14,236
10% Engineering	1,423
	$ 15,660
Say	$ 15,700/mile

* Two-directional roadway - 8 ft. on each side

** Crushed aggregate base course replaced by the paved shoulders.

*** s.f./s.y./c.f./c.y.: square feet/square yards/cubic feet/cubic yards

APPENDIX C

IBM FORTRAN CODING FORM

Form GX09-0011-6 U/M050
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PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC	PAGE / OF
PROGRAMMER	DATE		PUNCH	CARD ELECTRO NUMBER*

FORTRAN STATEMENT

COMM. (1)	STATEMENT NUMBER (2–5)	CONT. (6)	7–10	11–15	16–20	21–25	26–30	31–35	36	IDENTIFICATION SEQUENCE (73–80)
K	NP00	0	0108	01780	02042	30101	41410	00001	0	
		0	0208	20781	00051	60201	40410	00001	0	
		0	0308	20781	00061	40202	11200	00006	0	
		0	0408	01781	00017	70102	21111	00006	1	
		0	0508	08780	02041	60301	41210	00012	0	
		0	0607	18781	00021	80204	00601	00001	0	
		0	0607	18781	00021	80204	01401	00001	0	
		0	0708	08781	00072	60403	60401	00001	0	
		0	0808	08781	00071	60206	01110	00006	1	
		0	0908	20781	00082	70101	40211	00006	0	
		0	0908	20781	00082	70101	41011	00006	0	
		0	1008	01780	03041	60201	80411	00006	0	
		0	1008	01780	03041	60201	80411	00006	0	
		0	1108	26781	00051	20202	10310	00001	1	
		0	1108	26781	00051	20202	11110	00001	1	
		0	1209	03780	02042	20100	40210	00006	0	
		0	1209	03780	02042	20100	41110	00006	0	
		0	1308	01781	00062	70202	01211	00006	0	
		0	1407	18780	04031	90102	80210	00001	1	
		0	1407	18780	04051	40102	81110	00001	1	
		0	1507	18781	00071	60203	01911	00001	0	
		0	1607	24780	02051	60102	10901	00001	0	
		0	1708	22781	00081	70212	01010	00001	1	
		0	1808	22781	00071	60104	01201	00006	1	

* A standard card form, IBM electro 888157, is available for punching statements from this form

15

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PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC	PAGE 2 OF
PROGRAMMER	DATE		PUNCH	CARD ELECTRO NUMBER*

COMM. (1)	STATEMENT NUMBER (2–5)	CONT. (6)	FORTRAN STATEMENT (7–72)	IDENTIFICATION SEQUENCE (73–80)
K	NP00	0	190801781000426030301010000010	
↓	↓	0	200815780020416020141010000010	
		0	210823780010413020050211000231	
		0	210823780010413020050211000231	
		0	210823780010413020050211000231	
		0	210823780010413020051111000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
		0	210823780010413020051011000231	
↓	↓	0	220725780120411020021210000060	

* A standard card form, IBM electro 888157, is available for punching statements from this form

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Form GX09-0011-6 U/M050
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PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC	PAGE 3 OF
PROGRAMMER	DATE		PUNCH	CARD ELECTRO NUMBER*

COMM. | STATEMENT NUMBER | CONT. | FORTRAN STATEMENT | IDENTIFICATION SEQUENCE

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KNP000220725780120911020021310000060
     0230801780250426030300910000010
     0230801780250426030301010000010
     0230801780250426030301010000010
     0230801780250426030301310000010
     0230801780250426030300510000010
     0240724781000427020140311000010
     0240724781000427020141111000010
     0250731781000778021501111001251
     0250731781000778021501111001251
     0250731781000778021501111001251
     0260820781000516030210311000061
     0260820781000516030211111000061
     0270725780020911702021100100061
     0270725780020911702021100100061
     0270725780020911702021030100061
     0270725780020911702021030100061
     0270725780020911702021110100061
     0270725780020911702021110100061
     0270725780020911702021110100061
     0270725780020911702021120100061
     0270725780020911702021130100061
     0270725780020911702021130100061
     0280720781000916020251210000060
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8

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FORTRAN CODING FORM

Form GX09-0011-6 U/M050
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PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC	PAGE 4 OF
PROGRAMMER	DATE		PUNCH	CARD ELECTRO NUMBER*

COMM. | STATEMENT NUMBER | CONT. | FORTRAN STATEMENT | IDENTIFICATION SEQUENCE

```
1 2345 6 7........................................36
K NP00 0 3007 ... 
```

```
KNP000290724780050421100120211000120
     0290724780050421100120911000120
     0290724780050421100120911000120
     0290724780050421100120411000120
     0290724780050421100121211000120
     0300724781000415020140211001230
     0300724781006415020140211001230
     0310718781000917030170910000070
     0310718781000917030171010000070
     0310718781000917030171010000070
     0320718781000167020210211000010
     0320718781000167020210211000010
     0320718781000167020210911000010
     0330821780020748010901211000120
     0330821780020748010901211000120
     0340821781000416020140900000060
     0350820781000711020241011000030
     0360820781000711020240211000130
     0370808780060311030040311000060
     0380817780010717020281111000021
     0390817781000717020281111000021
     0400709781000811010091011002451
     0410709781000811010091011002451
     0420720780020878030101411000060
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* A standard card form, IBM electro 888157, is available for punching statements from this form

IBM FORTRAN CODING FORM

Form GX09-0011-6 U/M050
Printed in Canada

PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC	PAGE 5 OF
PROGRAMMER	DATE		PUNCH	CARD ELECTRO NUMBER*

STATEMENT NUMBER (1–5)	CONT. (6)	FORTRAN STATEMENT (7–72)	IDENTIFICATION SEQUENCE (73–80)
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	0	440721780060425020051011000021	
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	0	460801781000918010211111000030	
	0	470826781000917010141111000230	
	0	480826781000917010141310000121	
	0	490903780060411040140511000010	
	0	490903780060411040141311000010	
	0	500903781000411040100411000010	
	0	500903781000411040101211000010	
	0	500903781000411040100211000010	
	0	500903781000411040100911000010	

* A standard card form, IBM electro 888157, is available for punching statements from this form

CODE MASTER

1) Survey Identification: Kootenay National Park--00.
(column 1-5)

2) Case Number. (column 6-8)

3) Date: Month, Day, Year. (column 9-14)

4) Question #1. YES=1 , NO=0 (column 15)

5) Question #2. Number of visits (column 16 and 17)

6) Question #3. "Your home": (columns 18 and 19)

Vancouver Island; Lower Mainland	01
Northern B.C. (north of 53°)	02
Southern B.C. (south of 53°)	03
Calgary, Alberta	04
Rest of Alberta	05
Prairie Provinces (Saskatewan, Manitoba)	06
Rest of Canada (east)	07
North Western U.S.	08
Rest of U.S.	09
Other	10

7) Question 4a) destination: today; 4b) destination: total journey (columns 20 and 21)

Kootenay National Park	1
Radium	2
Invermere	3
East Kootenays	4
West Kootenays	5
Rest of B.C.	6
Alberta	7
Other	8

8) Question #5 a) stay in Kootenay National Park? (columns 22 and 23)

b) total journey? (columns 24, 25, 26)

9) Question #6. Age and Sex of Cyclists

(columns 27-28)

Age Female	#	Age Male	#
0 -10	01	0 -10	09
11-21	02	11-21	10
22-31	03	22-31	11
32-41	04	32-41	12
42-51	05	42-51	13
52-61	06	52-61	14
62-71	07	62-71	15
72-81	08	72-81	16

10) Question #7. YES=1 , NO=0 (column 29)

11) Question #8. YES=1 , NO=0 (column 30)

12) Question #9. Picnic sites=1

Campsites =2

Nature =3

Other--roadsigns =4

water supply=5

No Options =6

Motorcycles =7

(columns 31 to 35)

13) How the visitor arrived at the Park. cyclist =1

motor vehicle=0

(column 36)

APPENDIX D

DATA RESULTS

Question #1. Is this your first visit to Kootenay National Park? YES 39 NO 61

Question #2. Out of 61 people visiting previously:

Number of previous visits	Number of visitors	
1	22	36%
2	20	33%
3	2	3%
4	2	3%
5-19	10	17%
20+	5	8%

Question #3. Where is your home?

	Code	# of visitors
Vancouver Island; Lower Mainland	01	4
Northern B.C.	02	2
Southern B.C.	03	1
Calgary	04	48
Rest of Alberta	05	9
Prairies	06	2
Rest of Canada	07	13
North Western U.S.	08	6
Rest of U.S.	09	15
Other	10	0

Question #4. What is you destination: a) today; b) total journey

	a) today	b) total journey
Kootenay National Park	68	12
Radium	21	4
Invermere	0	22
East Kootenays	3	4
West Kootenays	0	3
Rest of B.C.	3	21
Alberta	5	25
Other	0	9

Question #5. How long (in days) will your:

a) stay in Kootenay Park be?

b) total journey be?

	Duration in days	# of visitors
a)	01	16
	02	63
	03	15
	04	6
b)	0-13	36
	14	12
	15-24	34
	30-59	15
	60+	3

Question #6. Age and Sex of Cyclists.

01 0	05 1	09 6	13 2
02 13	06 1	10 31	14 4
03 6	07 0	11 19	15 0
04 6	08 0	12 11	16 0

Question #7. Would you use such a trail?

YES 83 NO 17

Question #8. Would you be more inclined to use the trail if it was hard surfaced?

YES 74 NO 26

Question #9. What recreation options (if any) would you like to see along the trail?

1 40	5 5
2 39	6 29
3 26	7 3
4 2	

APPENDIX E

CYCLIST POPULATION ESTIMATE

	X	$\overline{X}$	$(X-\overline{X})^2$
July 18	11	5.11	26
July 19	2	-3.88	15
July 20	2	-3.88	15
July 21	1	-4.88	24
July 23	1	-4.88	24
July 24	11	5.11	26
July 25	12	6.11	37
July 31	3	-2.88	8
August 1	12	6.11	37
August 7	2	-3.88	15
August 8	4	-1.88	3
August 15	1	-4.88	24
August 20	8	2.12	4
August 21	3	-2.88	8
August 22	2	-3.88	15
August 23	21	15.12	229
August 26	4	-1.88	3
	100	0	513

mean $\frac{100}{17} = 5.88$

5.88 x 30 = 176 people/month

5.88 x 184 = 1082 people over 6 months possible cycling (May, June, July, August, September, October)

$s^2 = \frac{513}{17}$ $s^2 = 30.176$

<u>Standard Error</u> population variance:

$$\text{var}\ (\widehat{Y}) = s^2 \ \frac{N\ (N-n)}{n}$$

s^2 $30.176 \times \frac{184\ (167)}{17} = 54544$ $\therefore\ s = \sqrt{54544}$

Standard Error = $\pm$ 233

Confidence Limits (90%)

$\pm$ standard error x (t(0.1)(n-1))

= $\pm$ 233

= 233 x 1.740

= 405

Estimated six month population

is 1082 $\pm$ 405