

Nantucket

Bikeway

Master

Plan

Prepared by the NP&EDC

Nantucket

Massachusetts



NANTUCKET BIKEWAY MASTER PLAN
Nantucket, Massachusetts

prepared by the
NANTUCKET PLANNING & ECONOMIC DEVELOPMENT COMMISSION
1977

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TABLE OF CONTENTS

	<u>Page</u>
Introduction -----	
I. <u>Basic Studies</u>	
A. Existing Bikeway Facilities -----	1-1
B. Origin/Destination Information -----	1-1
C. Generation Data -----	1-3
D. Accidents -----	1-5
E. Costs -----	1-6
F. Inhibiting Factors to Biking -----	1-6
II. <u>Goals and Objectives</u>	2-1
III. <u>Bikeways Plan</u>	
A. Bikeways -----	3-1
B. Explanation of Proposed Routes -----	3-4
C. Bicycle Safety Education -----	3-6
D. Design Standards -----	3-7
E. Signage -----	3-10
F. Parking -----	3-11
IV. <u>Implementation</u>	
A. Funding Alternatives -----	4-1
B. Project Priorities -----	4-3
Appendix A-1975 Bicycle Questionnaire	

LIST OF ILLUSTRATIONS

<u>Tables</u>	<u>Page</u>
I. Destination Priorities -----	1-1
II. Cycling Time in Town -----	1-3
III. Registered Bikes -----	1-4
IV. 1975 Steamship Authority Bike Counts -----	1-4
V. 1975 Steamship Authority Automobile Counts --	1-5
VI. Minimum Curve Radii -----	3-8
VII. Stopping Sight Distances -----	3-9
 <u>Maps</u>	
1. Proposed Bikeways -----	3-2
2. Proposed Routes in Nantucket Center -----	3-3
3. Proposed Routes in Nantucket Center -----	3-3

INTRODUCTION

Nantucket is an island situated 25 miles south of Cape Cod. It is approximately 6 miles wide and 14 miles long, having a total land area of 50 square miles. Gentle rolling hills compose most of the terrain with the highest elevation being 111 feet above sea level. The landscape varies from beaches to marshes, cranberry bogs, open moorlands and pine forests. Nantucket's natural beauty in addition to her rich history provide an ideal bicycling environment.

Bicycles have been popular on Nantucket since the 1930's when tourism was just beginning on the island. In 1931 Harvey Young opened the first bike rental and repair shop with fewer than half a dozen bikes. Young's first bicycles were lightweight models (without balloon tires) which were not common at the time. Within the next ten years five more outfits were renting bicycles including: Austin's on Main Street, Pease's on South Water, Terry's Taxi on Middle Pearl, Whitfield Tennis & Cycle on South Beach and Cook's on Steamboat Wharf. In 'Sconset, Honest John Salvas charged 10¢ per tire for air, especially if the cyclist rode out from town. Lack of an inexpensive transportation system and the

fact that most distances to be traveled were relatively short encouraged bicycle use. Each successive summer season brought more tourists to the island and the bicycle business increased steadily until the end of World War II when both gasoline and automobiles became more readily available.



In the early '50s however, business was again booming as Nantucket was deluged with young summer people, all of whom rode bikes. About five new rental shops opened their doors during this decade. As the tourists and summer population increased yearly so did the number of cyclists on Nantucket's narrow roads. This tendency continued through the 1960s and 1970s with a few more bike shops coming into existence. The recent fuel shortage was also quite beneficial to the cycle shops. Bicycle sales throughout the country now outnumber sales of automobiles, and have since 1973.

Currently there are more bikes on Nantucket than ever before and more bikes are available to rent. One shop on Steamboat Wharf rents approximately 1000 bikes a day during the peak summer months. Obviously the rise in the number of cyclists increases the competition for roadway use. On Nantucket there is a definite safety hazard to both the cyclist and motorist as the majority of our roads are not capable of accomodating both simultaneously.

The Bikeway Master Plan seeks to provide a solution to this problem. Nantucket needs to expand its system of bikeways to allow both modes of transportation to coexist safely. In addition to the safety factor, there are numerous other advantages to having a good bikeway system. If cyclists were provided with marked routes and no longer had to compete with motorists more people would bicycle. This in turn would reduce traffic and parking problems, not only downtown, where congestion is the worst, but also at the beaches and other heavy traffic areas. Air pollution from automobile use would also be diminished, and bicycles are one of the most energy efficient forms of transportation. A well planned system would offer increased recreational opportunities and improved health to the community. In essence a good bikeway plan would be beneficial to all Nantucket residents whether they bicycle or not.

From basic bicycle statistics and a number of goals and objectives (sections I and II) a master plan for the island has been formulated (section III). Implementation of the plan is discussed in the final section (IV) of this report.

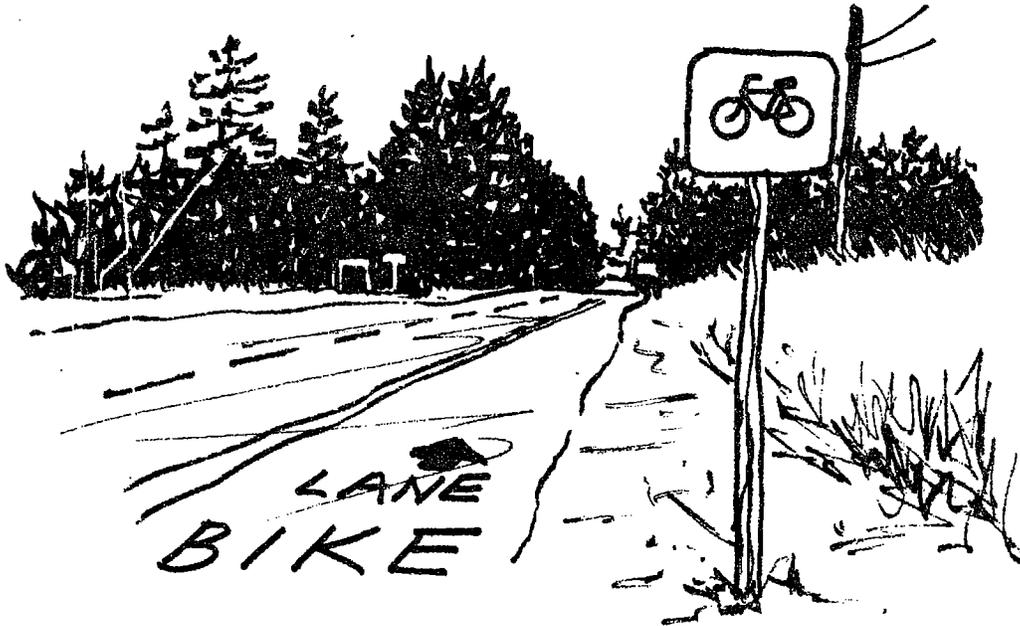
For the purpose of clarity the following key terms are defined below.

Bikeway: is a general term used to describe any facility for bicycle travel.

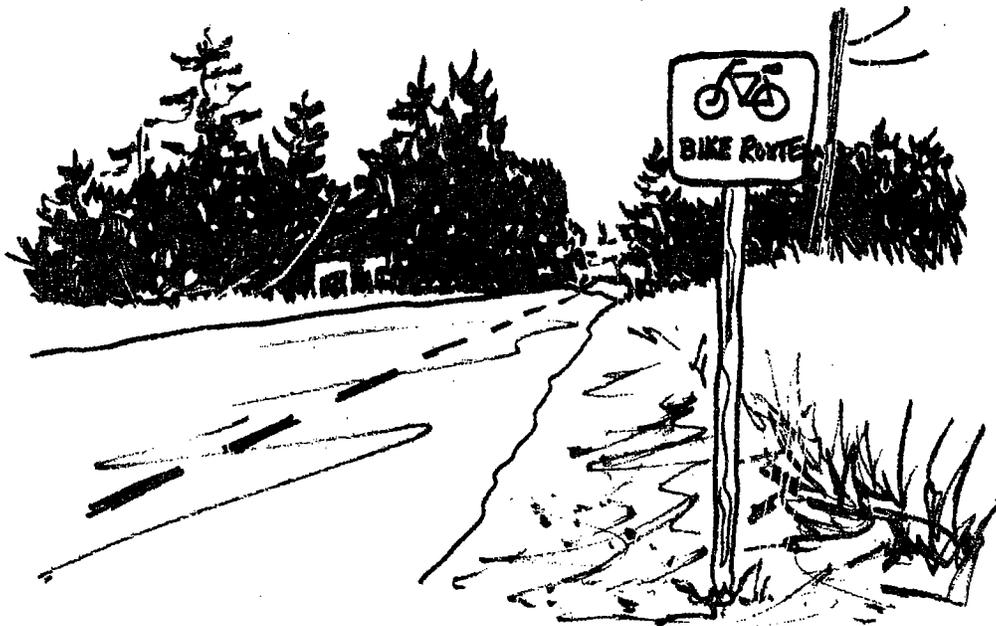
Class I Facility: A right-of-way completely separated from motor vehicle traffic, designated for the exclusive use of bicycles. Crossflows by pedestrians and motorists are minimized. This would include a bike path.



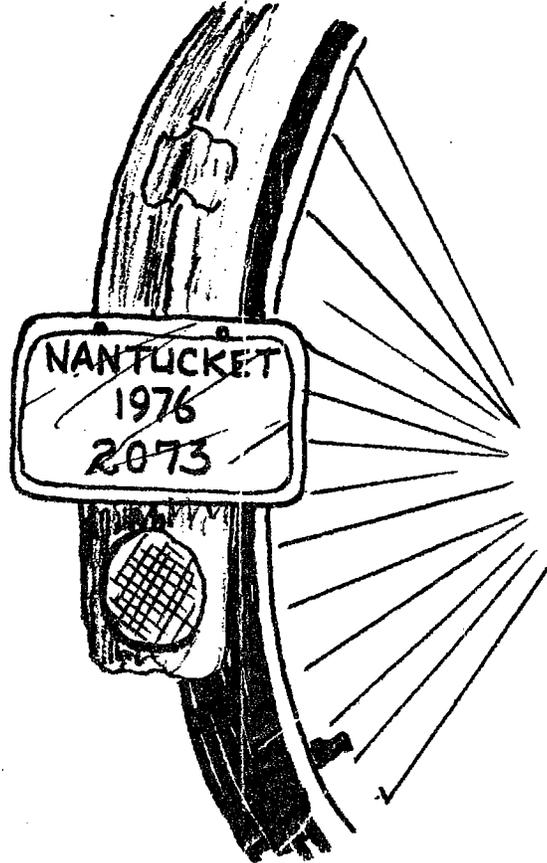
Class II Facility: A restricted right-of-way designated for the exclusive or semi-exclusive use of bicycles. Through travel by motor vehicles or pedestrians is not allowed, however crossflows for access to parking and parked vehicles et cetera is permitted. This would include a bike lane which is a portion of the road delineated by a visual or physical barrier.



Class III Facility: A shared right-of-way designated as such by signs placed on vertical posts or stenciled on the pavement. Any bikeway which shares its through-traffic right-of-way with either or both moving (not parking) motor vehicles and pedestrians is considered a Class III bikeway. A bike route is included in Class III.



I. BASIC STUDIES



A. EXISTING BIKEWAY FACILITIES

Existing bicycle facilities on Nantucket are minimal. Presently there is a seven mile Class I bikepath from the outskirts of town to Siasconset a small settlement at the eastern end of the island. This path finished in 1968, parallels the existing roadway and has been in need of surface repair for some time. In addition a similar path to Surfside, 3 miles in length, will be completed in 1977. Both of these paths (see Map 1, pg. 3-2) are heavy bicycle traffic areas, and thus are well used.

B. ORIGIN/DESTINATION INFORMATION

Two separate studies have been made to determine the cyclist's viewpoint in regard to priority destinations and funding of bicycle facilities on Nantucket. The first was a study conducted by the Nantucket Department of Public Works in 1973. The second was a Nantucket Planning & Economic Development Commission effort completed in 1975. Both relied on self-administered questionnaires.

1975 - Bicycle Questionnaire

Questionnaire cards were left at bicycle dealers and rental shops throughout the summer for clientele to pick up and answer voluntarily. (See appendix for sample questionnaire) Responses were tabulated in the fall of 1975. Of the 177 respondents:

- 14% were year-round residents
- 22% were summer residents
- 28% were less-than-a-month visitors
- 36% were less-than-a-week visitors

It is assumed that these percentages do not represent actual interest levels, but rather the proportionate number of customers in the shops.

When asked to number by priority ten possible destinations for out-of-town bike rides 45% (79 people) selected Surfside as their first choice. The table below illustrates the destination priorities chosen by all four groups for the remaining areas of the island.

TABLE I				
Destination Priorities				
<u>Preference</u>	<u>Year Round Resident</u>	<u>Summer Resident</u>	<u>Less than a Month Visitor</u>	<u>Less than a Week Visitor</u>
1	Surfside	Surfside	Madaket	Surfside
2	Sconset	Madaket	Surfside	Polpis
3	Madaket	Sconset	Cisco	Cisco

<u>Preference</u>	<u>Year Round Resident</u>	<u>Summer Resident</u>	<u>Less than a Month Visitor</u>	<u>Less than a Week Visitor</u>
4	Polpis	Cisco	Polpis	Madaket
5	Cisco	Wauwinet	Wauwinet	Sconset
6	Wauwinet	Polpis	Sconset	Airport
7	Airport	Quidnet	Eel Point	Wauwinet
8	Quidnet	Eel Point	Airport	Quidnet
9	Eel Point	Tom Nevers	Tom Nevers	Eel Point
10	Tom Nevers	Airport	Quidnet	Tom Nevers

These responses indicate the following bikeway corridor priorities: (1) Surfside (2) Madaket (3) Siasconset (4) Cisco (5) Polpis (6) Wauwinet (7) Airport. Priorities indicated in a 1973 DPW questionnaire were quite similar, excluding in-town destinations: (1) Surfside (2) Siasconset (3) Madaket (4) Cisco (5) Airport (6) Polpis (7) Wauwinet.

The third question dealt with the cyclist's willingness to pay a surcharge for bike path construction on bike rentals, ferry fees or bike registration. Overall 72% (126 people) said they would pay a surcharge. Most strongly in favor were the summer residents with 87%, and least in favor were the year round residents with 52%.

Finally the cyclists were questioned about how much cycling time they spent in the built up areas of town.

<u>% Cycling time in town</u>	<u>% of Total response</u>
0 - 25%	47%
25 - 50%	28%
50 - 75%	16%
75 - 100%	9%

Approximately half of all the respondents spend 25% or less of their biking time in the built up areas. In other words, the majority of bicycling is done outside of Town. This response supports the need for better out-of-town cycleways.

C. GENERATION DATA

Unfortunately there is no precise way to document the number of bicycles on Nantucket. In order to determine the total number of bikes we are dealing with, several sources must be consulted. A rough estimate can be made from the number of rental bikes available, Steamship Authority bicycle counts and bicycle registration figures, but this will not be completely accurate. These

sources are incomplete and the figure reached will be quite conservative. In addition the airlines do not keep figures on the number of bicycles they handle.

First consider rental bikes. Based on figures from seven of eight bicycle shops, there are approximately 2250 rental bikes available in the summer. Shop owners report that nearly all of their stock is rented daily during peak season.

To the number of rental bikes we must add those bikes which are owned by residents. One bike shop owner believes there are an additional 3000 bikes owned individually by Nantucketers. This estimate can be compared to police records of bicycle registrations for the last few years for verification.

TABLE III Registered Bikes	
<u>Year</u>	<u>Number of Bikes Registered</u>
1973	916
1974	697
1975	677
1976 (Jan-June only)	121
	<u>2411 Total</u>

Since bicycle registration is voluntary, recorded registrations represent only a portion of the bikes owned by island residents. However, a bicycle is registered only once therefore a total of 3000 bikes owned by islanders is probably a reasonable figure.

Finally we must also consider the number of visiting bicycles. Here are Steamship Authority bicycle counts.

TABLE IV 1975 Steamship Authority Bike Counts		
<u>Month</u>	<u>To Nantucket</u>	<u>From Nantucket</u>
Jan	9	14
Feb	5	5
Mar	64	62
Apr	259	248
May	680	702
Jun	1875	1748
Jul	2926	3131
Aug	3706	3328
Sept	1280	1430
Oct	447	473
Nov	84	103
Dec	7	12
	<u>11342</u>	<u>11256 Total</u>

These figures include only the bicycles that are walked aboard and not those carried on by vehicles. From this table one can see that August is the peak month for bicycle traffic. During this month there is a conservative average of 3000 visiting bikes, and most of these cyclists are unfamiliar with the island.

Combining all of these figures will give us the total number of cycles on Nantucket.

2250	Rental bikes
3000	Island registered bikes
3000	Visiting bikes
<u>8250</u>	<u>Total</u>



Now consider the competition - the number of automobiles also on the island's 60 miles of paved roadway. In 1975 about 5000 cars were registered on Nantucket. Since the population was 5540 in 1975, this is quite a high ratio (.9 or nearly 1 car per person).

Again we must add the number of visiting autos. Steamship Authority records for 1975 indicate the usual influx of cars for the summer months.

<u>Month</u>	<u>To Nantucket</u>	<u>From Nantucket</u>
May	1893	1357
Jun	3366	1805
Jul	3262	2866
Aug	3182	3732
	<u>11703</u>	<u>9670 Total</u>

From these counts one concludes that there are approximately 3000 additional visiting autos in the summer. Registered vehicles added to visiting vehicles results in a total of about 8000 cars.

Therefore on limited roadways there are roughly 8250 bicycles and 8000 automobiles vying for an unobstructed travelway simultaneously.

D. ACCIDENTS

Regrettably there is no accurate source for accident statistics. The Registry of Motor Vehicles has no figures on bicycle-car accidents. Nantucket Police also do not keep a record of cycle accidents other than in a daily log. One officer has estimated a top figure of 30 bike accidents for 1975. It is assumed that the low rate of bicycle collisions is due mainly to the slow speed of traffic in general on

Nantucket and to alert motorists, since very few cyclists here seem to be at all safety conscious. Considering the extremely high number of autos and bikes on this small island the accident rate is remarkably low.

For the country as a whole the National Safety Council estimates that there are one million bicycle injuries yearly that require medical attention. The majority of these accidents involve cars and in two-thirds of the incidents bicyclists were at fault. In order to lower the accident rate a public safety education program for both motorists and bikers is needed. Safety education is discussed more fully in section III of this monograph.

E. COSTS

Bikeway construction costs vary depending on differing local prices. Nantucket Department of Public Works figures for bike path construction are approximately \$110,000 per mile. This amount is for construction of a two lane Class I path with no painting, physical barriers or landscaping. Maintenance figures are somewhat sketchy since bike path maintenance is relatively new. However the Massachusetts Department of Public Works considers bike path upkeep similar to that of sidewalks. Frost, erosion and wear from use are the three causes of bike path breakdown. Surface patching would likely be necessary on Nantucket in five to eight years since we have minimal frost problems.

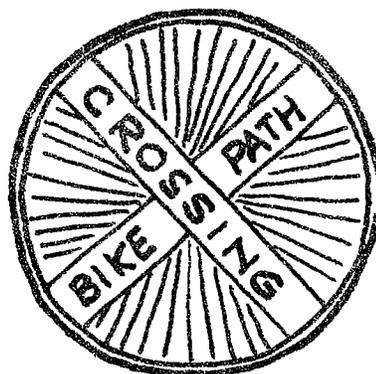
Costs for bike lanes would be considerably lower as this would involve only painting of the roadway to designate a lane and the accompanying signs. A bike route would be the least expensive since this requires very simple signage and little painting of the road surface if any. Maintenance for bike lanes and routes then would merely involve repainting.

F. INHIBITING FACTORS TO BIKING

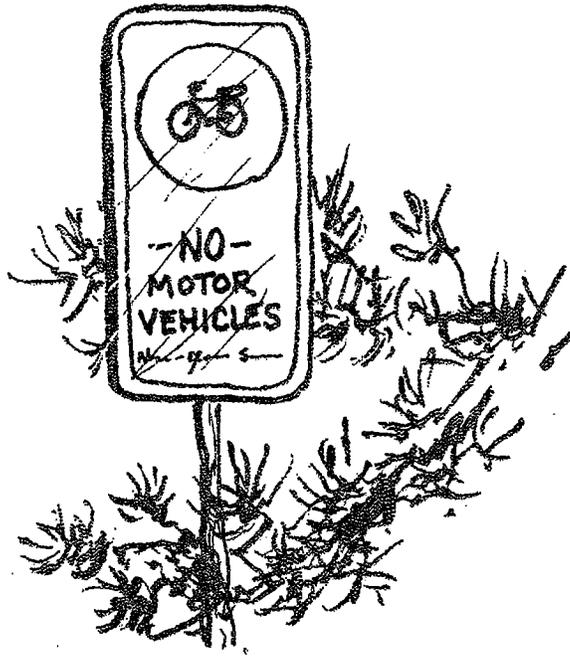
There are definite conditions that currently exist on the island which deter people from bicycling. Public enemy number one for the cyclist anywhere is the automobile since neither the auto driver nor the biker normally respect each other's rights. Unfortunately, the bicycle is considered a secondary vehicle in traffic and this is an image which must be changed for the public, motorists and cyclists alike. Another major safety factor on Nantucket is narrow roads, the majority being only 20 feet wide. The narrowness of the roads combined with parked cars in town make it nearly impossible for traffic to flow when cyclists are present. Out of town two cars from opposite directions cannot pass when there is also a bicyclist on the road. The motorist behind the biker must slow down and allow the other car to pass before he can continue. In addition many island roads are in need of surface repair and most have rough natural shoulders.

Bicycle theft is another deterrent. Nantucket Police records are somewhat vague as reported thefts are not always dated. However at least 70 bicycles were stolen in 1975. One officer estimates 100 thefts for 1975. A number of the stolen bikes were not locked and many were unregistered.

All of these conditions combine to discourage people from biking. Basically, these are public education and safety issues which hopefully will be remedied by this plan. Other minor factors which also inhibit people from cycling include: a shortage of bike racks in town and at the beaches, exposure to automobile pollution, attacking dogs, wind and weather. More bicycle parking facilities could be provided, but little can be done about the other variables.



II. GOALS & OBJECTIVES



GOALS AND OBJECTIVES

The goal of the Bicycle Path Master Plan is to develop an island-wide bikeway system and promote bicycle travel as an integral part of Nantucket recreation and transportation. Specific objectives include the following:

1. To promote bicycle safety and reduce accidents through increased publication and enforcement of bike laws, and through public safety education.
2. To create a separation of vehicular and bicycle traffic whenever possible either through separate paths, physical barriers, street delineation or signage.
3. To construct new Class I bikeways to outlying areas and to designate bike lanes or routes in the built-up areas, resulting in a series of connected loops when feasible.
4. To promote bicycle registration in order to reduce theft and increase the possibility for recovery of stolen bikes.
5. To reduce traffic congestion and parking problems through the promotion of bicycle use over automobiles.
6. To improve recreational opportunities and community health in general.
7. To support the local economy through continued and increased bicycle business.
8. To reduce air pollution from automobiles and conserve energy resources through increased bicycle use.
9. To periodically review and update the Master Plan as community needs and State and Federal legislation change.

III. BIKEWAYS PLAN



A. BIKEWAYS

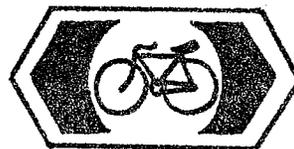
Obviously there are many different types of bikeways, which can be classified into three categories. Definitions of Class I, Class II and Class III bikeways were previously listed in the introduction. Each of the three classes has its merits.

Class I bikeways offer maximum safety and enjoyment for the cyclist but at a premium cost. The ideal facility, an independent bike trail (I) has its own right-of-way and is completely separated from roadways. On the opposite end of the scale, Class III bikeways are the least expensive but also the least effective. Signed routes (III) which have a shared right-of-way, do not offer enough significant advantages over regular streets other than to warn motorists that cyclists may be present. Class II facilities however, provide a good compromise. A Class II bike lane offers more safety to the cyclist than a bike route (III) yet is less costly than a separate path (I).

Each cycleway has its advantages and disadvantages and many factors affect the decision to use a specific type. Variables such as flow of traffic, varying destinations, different trip types or bicycle uses, scenic and historic routing, slope of land, available land, environmental impacts and total cost must be considered in addition to safety.

On Nantucket, available space and economics will play a major role in determining the types of bikeways implemented. Initially bike routes may be the most feasible especially in Nantucket Center. Unfortunately many island roads are too narrow to accomodate bike lanes. Out of town destinations seem to be best served by separate paths. Currently there are two existing bike paths both beginning on the outskirts of town, one continuing to Siasconset, the other to Surfside. A third facility to Madaket is on the drawing board and is scheduled for completion in 1978. Hopefully, some of these areas can be combined to serve as loops. For example, a bikeway to Madaket could include Eel Point, and a Polpis route could encompass Wauwinet and Quidnet and form a loop by adjoining the current Siasconset path. Perhaps the existing Surfside path could be continued to the Airport to complete a loop. This would provide variety in routes for recreational purposes yet still cover the desired destinations directly.

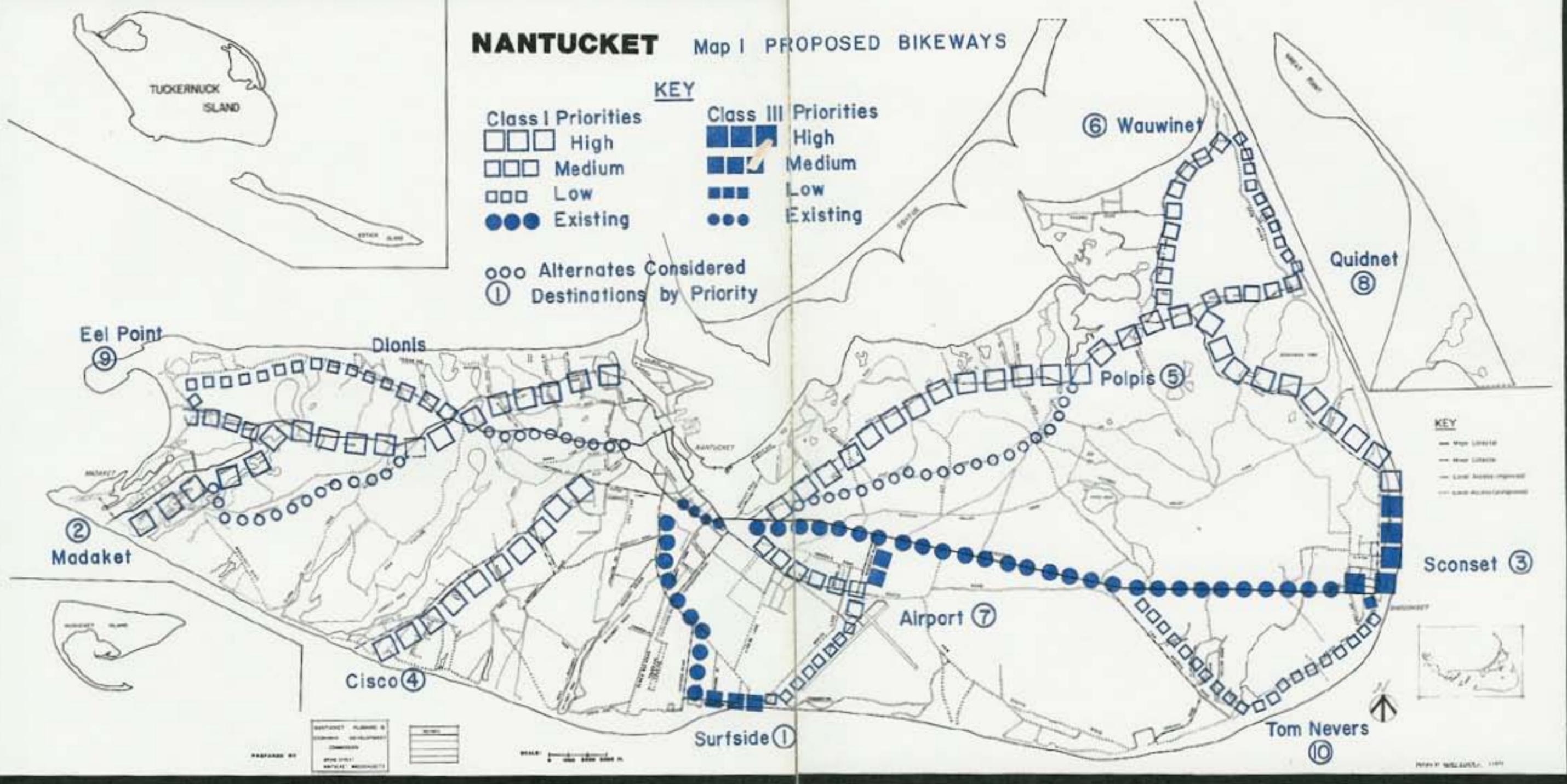
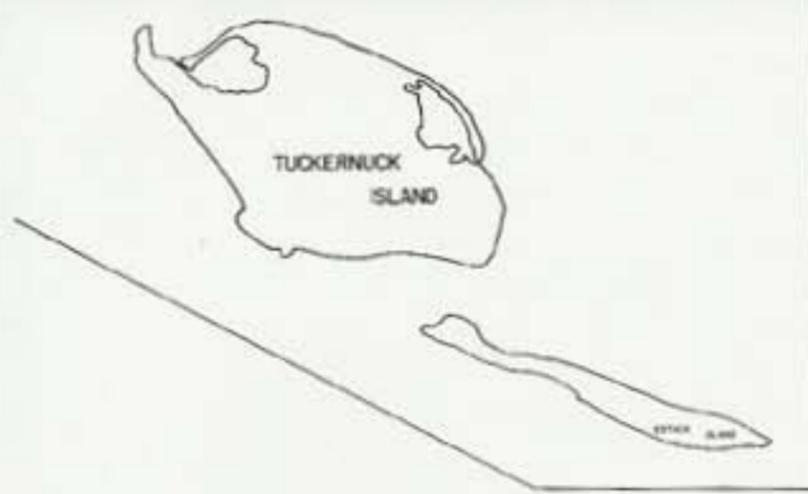
Following are two maps indicating proposed and alternate routes for bikeways out of Town (Map 1) and within the downtown area (Map 2).



NANTUCKET Map I PROPOSED BIKEWAYS

KEY

Class I Priorities	Class III Priorities
□□□ High	■ ■ ■ High
□□□ Medium	■ ■ ■ Medium
□□□ Low	■ ■ ■ Low
●●● Existing	●●● Existing
○ ○ ○ Alternates Considered	
① Destinations by Priority	



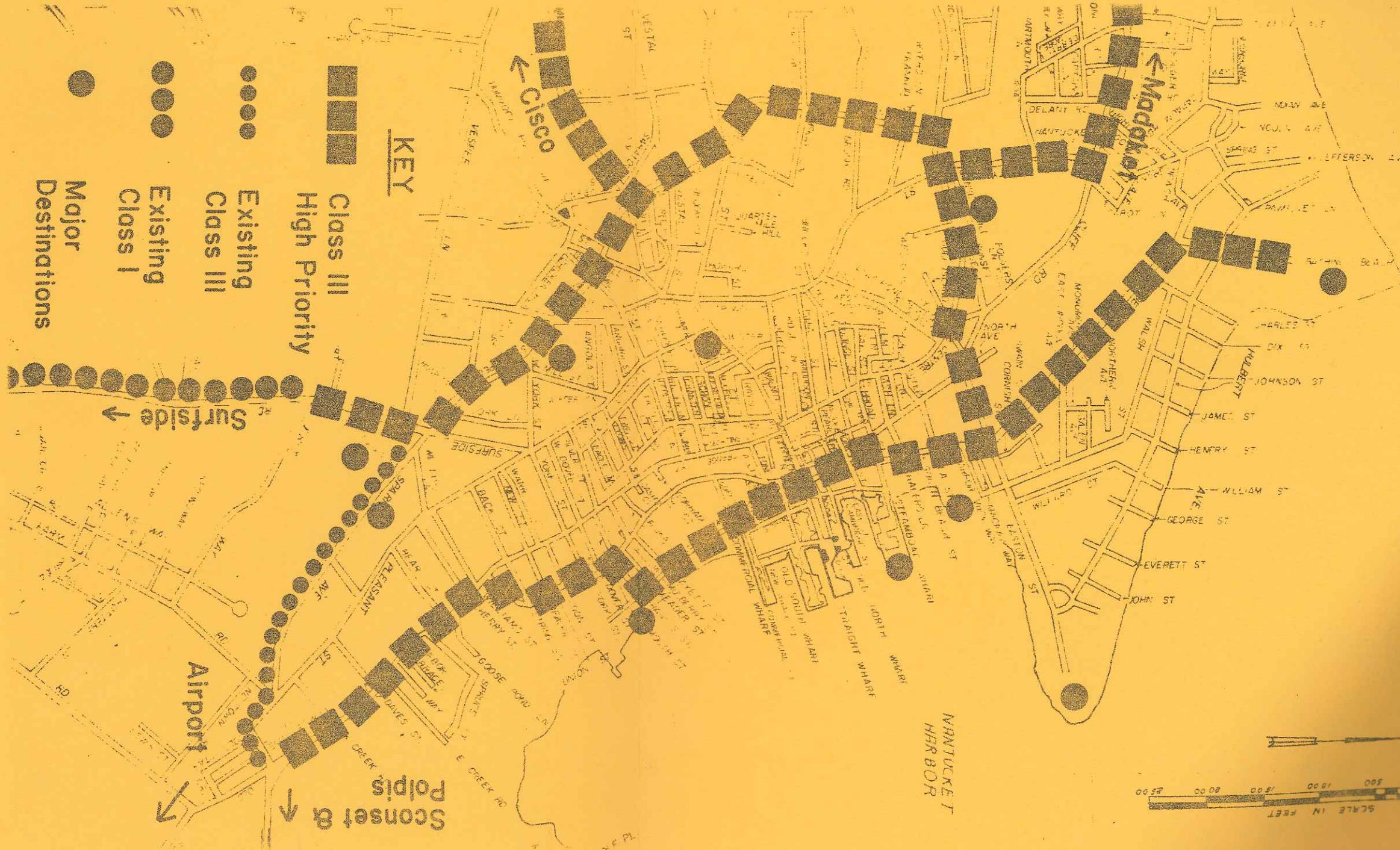
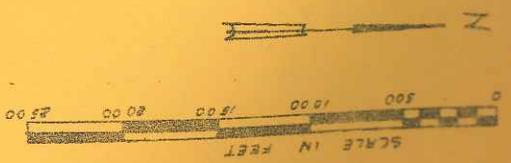
KEY

- Main Road
- Minor Road
- Low Access Improved
- Low Access Proposed



PREPARED BY: [Logo]
 NANTUCKET PLANNING & DEVELOPMENT COMMISSION
 2000 STATE STREET, NANTUCKET, MASSACHUSETTS 01906
 SCALE: 1" = 1/2 MILE (1:125,000)

Map 2 PROPOSED ROUTES in NANTUCKET CENTER



KEY

■ ■ ■ ■ Class III
 High Priority

● ● ● ● Existing
 Class III

● ● Existing
 Class I

● Major
 Destinations

B. EXPLANATION OF PROPOSED ROUTES

Potential bikeways for the island were chosen after careful consideration of all feasible alternates. Proposed routes illustrated on Maps 1 and 2 are shown by class of facility and by priority. These priorities will be considered in three ten year phases meaning that a high priority facility will be considered for implementation during Phase I (1977-1987), a medium priority during Phase II (1987-1997) and a low priority during Phase III (1997-2007). By considering the proposed facilities in phases this Master Plan is given a realistic time frame.

Proposed Out-of-Town Bikeways Phase I-Class I

Madaket Road - Due to the length and curviness of this road it was felt that a separate path was needed to provide for bicyclist safety. This facility will be a Class I path for the most part but may be a Class II lane in some spots as dictated by dense natural vegetation and wetland areas along the roadway, as well as two bridges that must be crossed. The decision to parallel Madaket Road rather than to route part of the facility down Massasoit Bridge Road was both economic and aesthetic. First, the Town does not own Massasoit Bridge Road and second, it is currently a dirt road with virtually no development on it. Although this road has a gentler terrain it was felt that the area should not be spoiled with pavement for a bikeway. Another option was to route part of the path along the Eel Point and Warren's Landing roads, which would be more scenic and would avoid one narrow bridge. However this alternative was also dropped due to the additional length of Eel Point Road and the psychological drawback to cyclists of a route which would double back considerably. Madaket Road provides the most direct and least expensive location for a path since the Town owns this right-of-way. Eel Point Road is still a desirable location for a path however, and for this reason has been given a low priority (phase III) as a Class I facility.

As for the first portion of the Madaket bikeway, Cliff Road was selected rather than the section of Madaket Road nearest to Town. While Cliff Road has a more difficult gradient it is more scenic, less travelled by motor vehicles and does not have as many dangerous sharp curves as the eastern part of Madaket Road has.

Hummock Pond Road - This road offers the only possible route to Cisco. Again a separate path is suggested as the road is lengthy, has numerous curves and is heavily travelled by cyclists.

Polpis Road - Since the Polpis Road is also quite a winding road and has a good deal of motor traffic on it a separate path would seem to be the safest and most appropriate facility for this area. The path would essentially parallel the road (diverting from it where possible) from its beginning near the rotary, to Sconset. A Class III route through the center of Sconset would connect the Polpis path to the existing Sconset path. This would mean dropping the alternate of Pout Pond Road for a section of the bikeway. Reasoning behind this is similar to the dropping of the alternate Massasoit Bridge Road in Madaket.

Pout Pond Road is also an unimproved dirt road, is not Town owned and has no development on it currently.

Phase II - Class I

Dionis Spur - The east end of Eel Point Road has been designated as a second priority path mainly to provide access to Dionis Beach, a high use public beach. The paved section of this road is heavily used by cyclists, while there is relatively low use by motor vehicles presently. This facility would also be a step toward eventually forming a loop between the Madaket Road and the Eel Point conservation area.

Warren's Landing Road - This road has been assigned a phase II priority to permit access by cycle to the Madaket Harbor and to offer a short scenic side trip from the Madaket Road path. Additionally Warren's Landing Road will function as a portion of the Dionis-Eel Point Loop. A substantial amount of residential development is proposed for this area, thus a path was felt to be the most appropriate facility.

Old South Road-Wauwinet Spur-Quidnet Spur - These three roads have all been selected as necessary links to medium priority destinations chosen by bicyclists. Little choice was available in their selection. These paths will make use of the only existing roads to outlying areas in an attempt to cover the desired destinations and still create a system of loops. Although Nantucket is criss-crossed with dirt roads it would be contradictory to pave otherwise undeveloped areas. A great deal of expense can be saved by using the existing legal rights-of-way owned by the Town on the major paved roads, not to mention the advantage of avoiding eminent domain takings.

Phase II - Class III

Nonantum Avenue in Surfside and Nobadeer Road (near the airport) were chosen as connecting links between Class I facilities. Neither of these roads are major traffic arteries and both cover relatively short distances so that their designation as bike routes would not be unsafe nor cause traffic problems. Separate paths are not needed here.

Phase III - Class I

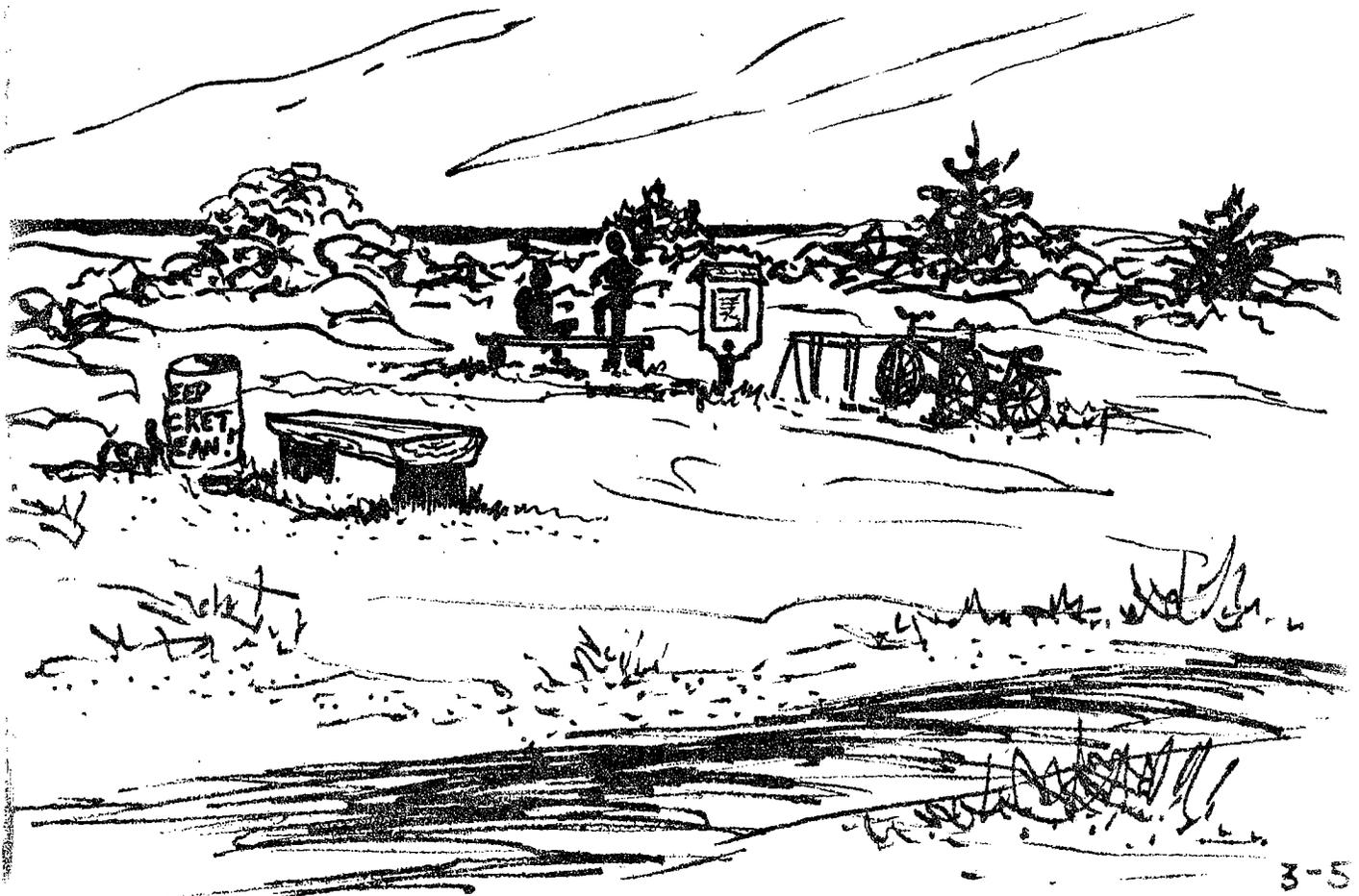
Macy's Lane-Tom Nevers Road-Eel Point Road (from Dionis to Warren's Landing Road) - These roads have all been given a phase III time schedule since they received the lowest priority from cyclists. In each case it was felt that a separate path was needed due to future residential development in these areas.

Proposed Routes in Nantucket Center Phase I - Class III

Selection of in-town routes (Map 2) was based mainly on traffic flow and street widths since there is a definite traffic congestion problem downtown. Simplicity of the route, as well as existing gradients and road conditions were

also considered. Streets that were chosen are not ideal but seem to be the best solution. These create a hub around the central downtown area and provide access to points of interest and major destinations in the Town. The one existing partial facility, a Class III sidewalk-bikeway on Sparks Avenue has been incorporated in the down town routes. Other routes were chosen as connectors to the outlying paths. It is fully realized that the in-town routes must be heavily publicized or their use will be only incidental. Hopefully the majority of cyclists will funnel into the designated routes and thus alleviate some of the confusion of cyclists on all downtown streets during peak season.

Coincidentally, the Conservation District of Nantucket is proposing a series of rest stops (17) for bicyclists along major island roads which are compatible with the proposed paths and routes of this plan. Each spot will most likely consist of two simple plank benches, a trash barrel, bike rack and bulletin board with a map showing points of interest and distance figures, as illustrated below.



C. BICYCLE SAFETY EDUCATION

Public safety education is the most important factor in making bicycle transportation work. It will be years before adequate bicycle facilities will actually be available on a large scale and in the interim we shall all have to cope with the existing conditions. Cyclists must be made aware that a bicycle is not a toy on the road and that it must be operated under the rules of the road, or suffer the consequences of a ticket and or fine. According to previously mentioned National Safety Council estimates it is the bicyclist who is the cause of an accident in two out of three cases. Frequently the cyclist is unaware of the traffic around him or fails to signal or look before turning.

As for the motorist, he too must become cognizant that the bicyclist has a legal right to use the road and is not just a nuisance to be cut off in traffic, or under cramped conditions literally run off the road.

How can the image of the bicycle be upgraded and made serious to the cyclist and motorist too? Nantucket Police are making a concentrated effort this year (especially during the summer months) to alert bikers to the proper rules of the road. Posters listing bicycle rules are being displayed in all of the bike shops and in other clearly visible locations in town. Officers are issuing written warnings to offenders on the first violation (or a ticket at their discretion) and a ticket for the second offense. Tickets for a simple violation carry a \$3.00 fine. In addition the department is publicizing their increased efforts in the weekly newspaper and with ten second spots on the local television station. The only short-coming of this program is that the police are greatly out-numbered by bicycle offenders. Many cyclists here are visitors and thus are more likely to break the rules since they are unfamiliar with the roads and are sightseeing at the same time. However this program is an excellent beginning at reaching adult bicyclists.

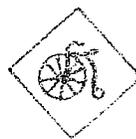
Although the adult bicycling population accounts for the greatest increase percentage-wise in accidents, the largest number of accidents still occur in the five to fourteen age bracket. Perhaps bicycle safety could be incorporated into physical education at the elementary school level, in order to properly teach youngsters the rules of the road while they are forming their bike riding habits. A project along these lines has been tried in Newton, Massachusetts by the police department there and has proved very successful.

One way of informing motorists of the legal rights of bicycles is through the state's Drivers' License Manual. In Massachusetts this booklet now includes a page on bicycles and their proper treatment by motorists, which is a step in the right direction. However this is not something that is read frequently by the public in general. Perhaps short bicycle safety ads appealing to the motorist could be carried on national television. Other than media exposure, only signs marking bikeways will constantly remind auto drivers to be alert for cyclists.

D. DESIGN STANDARDS

In designing a bikeway there are many variables to be considered including: bikeway width and height clearances, design speeds and curves, grades, pavement structure and sight distances. Specifications for each of these factors are discussed below. The majority of the figures used are taken from the Guide For Bicycle Routes put out by the American Association of State Highway and Transportation Officials.

Width and Height Clearances



To determine adequate bikeway widths one must begin with the dimensions of a bicycle. The average cycle is 2 feet in handlebar width, 5 3/4 feet in length and 7 1/2 feet in height with a rider, including 1/2 foot vertical pedal clearance. In addition to the actual space occupied, operating space must be provided. An additional 3/4 foot in width on each side of the bike is considered minimum operating space while an extra foot per side is desirable in a one lane operation. Between two bicycles a minimum of 1 1/2 feet is recommended for maneuverability (2 1/2 feet for higher speeds). Therefore for a one lane bikeway a minimum surface width would be 3 1/2 feet (2 feet bike width, plus 3/4 foot operating space per side) with 4 feet being preferred. For a two lane operation a minimum surface width would be 7 feet (two 2 foot cycles, 1 1/2 feet between bikes, 3/4 foot operating space between each bike to the pavement edge) with 8 feet adding a measure of comfort (2 1/2 feet between bikes). Accordingly a three lane bikeway would require a minimum surface width of 10 1/2 feet with 12 1/2 being preferable; a four lane bikeway minimum surface width would be 14 feet with 17 feet being preferred.

For safety purposes there should be an extra 2/3 to 2 feet between the pavement edge and any lateral obstructions. Allowance for vertical clearance should be a minimum of 8 1/6 feet to 10 feet from the pavement to any overhead objects.

Other conditions affecting lane widths are curbs and parking shoulders. It is recommended that 1/2 to 1 foot be added to a bikeway on a street which has a raised curb on one side. With a raised curb on both sides 1 to 2 feet should be added to bikeway widths. When parked cars are present 2 feet should be added. The average parking shoulder is 8 feet wide, while a motor vehicle travel lane is 10 to 11 feet wide.

From the figures given above one can determine various roadway widths depending on the number of lanes desired and parking conditions. Providing minimum bikeway requirements may be economical in some cases, however the additional bikeway widths noted as desirable are well worth the expense to ensure cyclists' safety and the use of the facility. In fact, where a separate path is involved a surface width of 8 feet or more may be less expensive in that the surface can be mechanically spread rather than manually spread. In addition an 8 foot width would be adequate for maintenance vehicle access. An independent path should be located at a minimum distance of 20 feet, 30 feet preferably, from the edge of the travel way unless there is a natural barrier (ditch, bushes) between the two.

Speeds and Curves

A bikeway must be designed to accommodate the desired speed of the faster cyclists. Whatever speed is chosen will be the "design speed." Obviously cyclists move at different paces depending on their physical fitness, quality of bicycle and route conditions. The majority of riders travel between 7 and 15 mph, while 10 to 11 mph is average. Therefore the design speed should be at least 10 mph and slightly over 15 mph to allow for increased downhill speeds.

Curves in the bikeway must be compatible with the design speed. The following figures are useful when there is little or no superelevation (otherwise they should be slightly reduced).

<u>Design Speed</u>	<u>Design Radius</u>
10 mph	15 ft.
15	35
20	70
25	90
30	125

Superelevation rates are not yet fully researched, however .02 per foot is the recommended minimum rate (.05 in general) of cross slope necessary for drainage purposes.

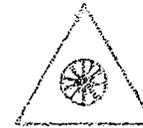
Since bike lanes and bike routes generally follow a roadway, curves encountered have been designed for motor vehicles and thus will be quite sufficient for bicycles.

Grades

Determining negotiable grades for a bicycle involves several factors. One must consider the length of the grade, and again the physical fitness of the rider, surface conditions, type of bicycle and the wind element. Since all of these factors vary there is no one set of design specifications. Studies in the U. S. have indicated that a gradient of 5% should be the approximate maximum. In general bikeway grades should not be more than 10% on a very short stretch; a grade of 5% should not exceed 300 feet and a grade of 2% should be no longer than 1,500 feet as the absolute maximum. Preferably the latter two gradients would be no longer than 100 feet and 500 feet respectively. As a rule the percent of inclination is directly proportionate to the length of grade. In other words the lesser the incline (grade) the longer the section of bikeway may be; the steeper the incline the shorter the section of bikeway must be.

On a bike lane or route there is little choice in bikeway gradient since these two types of facilities would normally be alongside an existing roadway. For this reason the gradient of a street should be considered before selecting it as a prospective bike route. In the case of an independent path there is latitude in designing bikeway grades and these should be kept to a minimum whenever possible to pro-

note maximum usage of the facility.



Sight Distance

Sight distance is another factor in bikeway design and is a major safety consideration. A bicyclist must have a clear view of the upcoming roadway for several feet, depending on his speed, for stopping purposes. The length of sight distance needed depends on the design speed and grade of a section of the bikeway. The following are recommended sight distances for various situations.

<u>Downhill Grade</u>	<u>10 mph</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>
0%	50 ft.	85	130	175	230
5%	50	90	140	200	260
10%	60	100	160	230	310
15%	70	130	200	300	400

The above figures are assuming a perception-reaction time of 2.5 seconds and a skid resistance of 0.25 for a bike with one good brake on a paved surface. An unpaved bikeway would require additional sight distance. Again an existing roadway should be examined with sight distances in mind before locating a bike lane or route there.

Pavement

Finally, the pavement composition must be decided upon. The main requirement for roadway structure is that it be sturdy enough to support not only bicyclists but also possible motor vehicles or maintenance vehicles that may need to traverse or use the bikeway. Normally the pavement is composed of three layers - a subgrade, base and surface.

Surface matter must be stable and passable in all kinds of weather and should be either an asphaltic material or portland cement concrete. Possible base materials may be aggregates (crushed stone, gravel, slag), soil cement, stabilized earth, portland cement concrete or asphaltic concrete. The above mentioned materials may be used in various combinations.

One of the most successful combinations is a compacted subgrade with 3 to 4 inches of aggregate base and a 1 1/2 to 2 inch asphalt surface. Another satisfactory combination is 3 to 6 inches of hot-mix asphalt placed directly on top of the compacted subgrade. The depth of the asphalt is dependent upon the subgrade quality. In this instance normal highway mixes may be used if they are densely graded (no more than 10% air voids) and a finely graded aggregate should be used for the sur-

face. As was previously mentioned many asphaltic-concrete surfaces, when used in an 8 to 12 foot width can be mechanically spread and thus may be more economic than other surface materials.

A third pavement combination is a compacted subgrade with 3 to 4 inches of aggregate base and 4 inches of portland cement concrete surface. One consideration here is to make certain that the cement surface is of a sufficient depth to support maintenance vehicles (otherwise normal sidewalk structure is adequate for bicycles).

On Nantucket aggregate is not readily available and cement is very expensive, thus the choices available here are rather defined. For the new Surfside Path 3 inches of type F1 asphalt mix was used for the surface on a 4 inch base of sand and loam hardening. However the Massachusetts Department of Public Works would prefer that 3 inches of type I (a higher grade) mix be used on a 3 to 4 inch base of processed stone, unless this is too costly to bring to the island.

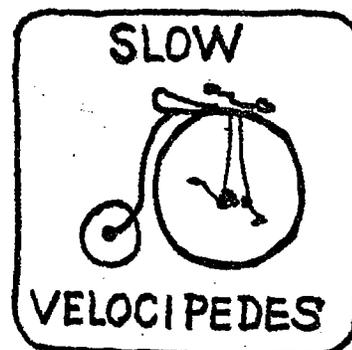
E. SIGNAGE

Bikeway signing is fairly standard throughout the U.S. Proper signing is a necessity for bicyclist safety, for making motorists aware of a bicycle facility and to encourage the use of designated routes. Bikeway signs should be placed at strategic spots such as the following:

- 1) Decision points-to indicate a directional change and to confirm the change once it has been made.
- 2) With regularity along the bikeway to assure cyclists that they are on the facility and to notify newcomers.
- 3) Where a route begins, ends, intersects or crosses a roadway, motorist warnings are needed.
- 4) Where obstacles or hazards are present a cyclist warning is preferable at least 50 feet in advance.

In addition to posted signs pavement stencils, including words, directional arrows and striping may be used to indicate a bikeway and also help to discourage vehicles from creeping onto the facility. Indeed various routes might be color coded with different colors of pavement striping. A cyclist could then follow the "blue line" to Madaket or take the "green line" to Cisco.

Following are sketches of possible signs, not necessarily standard, which might be more appropriate and in-keeping with Nantucket's historical character.



F. PARKING

While parking a bicycle is generally not considered a problem in low use areas and is in fact an advantage of cycling, parking facilities should be provided in high-level use areas such as Nantucket. Presently there are a few bike racks in the Town center and at some of the major beaches, but there is a noticeable shortage especially in the outlying areas. Lack of anything to secure a bicycle to, particularly at the beach, could discourage cyclists from frequenting that spot and may even encourage them to drive a car instead. Possibly, the Town could provide more racks at public beaches and at heavily used private areas with the consent of the landowner. In the built-up areas groups of shopkeepers could jointly purchase bicycle racks. A security rack for two sided use with 20 bike spaces costs approximately \$200.00.



Ideally, a parking facility should be weather protected and in public view for maximum security. However, a basic parking facility should be:

- 1) Convenient to use
- 2) Secure from vandalism
- 3) Safe for the bicycle
- 4) Have a clear and uncomplicated design
- 5) Have low operation and maintenance requirements
- 6) Be properly and safely installed

In more urban areas a bicycle parking facility is often designated by a posted circular sign of a black bike tire with spokes on a yellow background marked with the letter P (also in black) in the center of the tire.



IV. IMPLEMENTATION



It is obvious that Nantucket will not be able to afford the construction of all the facilities proposed in this plan at once. It is more likely that these bikeway improvements will be extended over a 30 year period, depending upon how much financial assistance may be secured from State and Federal sources.

The following is designed to summarize, in a step by step fashion, the sequence of events that is suggested for implementing this Bikeway Master Plan.

Phase I - 1977 to 1985

1. Complete construction of Surfside Bicycle Path
2. Secure funding for Madaket Bicycle Path.
3. Design and Construct Madaket Bicycle Path.
4. Construct five bicycle rest stops as per plans of Nantucket Conservation District.
5. Sign all in-Town Class III bike routes.
6. Maintain bicycle education effort.
7. Update Bikeway Master Plan.

Phase II - 1985 to 1995

1. Secure funding for Polpis Road Bike Path.
2. Design and Construct Polpis Road Bike Path.
3. Maintain bicycle education effort.
4. Update Bikeway Master Plan.

Phase III - 1995 to 2005

1. Secure funding for Cisco Bike Path, Airport Bike Path and Dionis Bike Path.
2. Design and Construct Cisco Bike Path, Airport Bike Path, and Dionis Bike Path.
3. Maintain bicycle education effort.
4. Update Bikeway Master Plan.

Phase IV 2005 and after

Phase four will consist of closing off the beginnings of various bikeway loops including the Tom Nevers Head loop, the Wauwinet-Quidnet loop, the Nobadeer loop and the Eel Point loop.

APPENDIX



Nantucket Planning & Economic Development Commission
BICYCLE QUESTIONNAIRE-1975

Please fill out and drop in the mailbox. Thank you.

- 1) Year-round resident _____ Less than a month visitor _____
Summer resident _____ Less than a week visitor _____
- 2) Place a number next to the following destinations according to your
priority for out-of-town bike rides. (1st choice, 2nd, etc.)
Surfside _____ Wauwinet _____ Airport _____
'Sconset _____ Tom Nevers _____ Quidnet _____
Madaket _____ Eel Point _____ Other: _____
Polpis _____ Cisco _____
- 3) Would you, as a biker, pay a surcharge for bike path construction
either on bike rentals, ferry fees, or bike registration? _____
- 4) What percentage of your bike-riding time is spent within the built-up
areas of Town? 0-25 _____ 25-50 _____ 50-75 _____ 75-100 _____

