URBAN MOBILITY: An Examination of the Role of the Bicycle

by

ANDREW ROBERT SMITH

A practicum
submitted to the University of Manitoba
in partial fulfillment of the
requirements for the degree of

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Faculty of Architecture
University of Manitoba

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ABSTRACT

Faced with the continual expansion of city roads to ameliorate the frequent traffic jams, long journey delays and clogged roadways caused by the seemingly inexhaustible supply of private automobiles, many North American cities have looked for new methods by which to alleviate these problems. Cities have responded to these transportation problems by forming Transportation Systems/Demand Management agencies. Their mandate is to solicit techniques by which the demand for space on the city streets could be decreased, thereby reducing the need for frequent and costly expansions of the city road network. These programs are so vital that they have now become an integral part of the overall land-use planning process.

One component of the new transportation schemes has been to incorporate the bicycle into the master plan. The benefits of the ubiquitous bicycle are widely known. It offers the user a quick, inexpensive, healthy and convenient mode of travel, but additional benefits also accrue to society - it is free of pollution and noise, consumes no fossil fuels, and places the individual in an excellent scale relationship with ones surroundings.

The purpose of this practicum was to provide the City of Winnipeg with a general working framework that is necessary to begin the formulation of a bicycle master plan for the municipality. To that end, a number of North American cities were studied to understand the bicycle planning process undertaken in these communities. These examples provide a listing of recommended solutions for the improvement of cycling opportunities in those cities, which can be applied to the situation in Winnipeg. To assist in the actual construction of bikeways a directory of the most recent and innovative facilities, designs and solutions for bikeways have been gleaned from cities across North America. All recommendations are designed to improve conditions for those seeking the recreational pursuits of bicycling and the utilitarian (commuting) cyclists. The potential for creating a city-wide bicycle network is also examined through greater use of the park system. To supplement the facility initiatives, a critique of the education and enforcement programs currently operating in Winnipeg has been conducted. To ensure that minimum bicycle safety standards are met, it is recommended that these programs undergo modification and expansion.

ACKNOWLEDGEMENTS

As ideas and thoughts are constantly exchanged between individuals during the development of a project, invariably the final product becomes a blend from all those involved. To this end, I would like to extend my gratitude to the committee members who provided invaluable advice, assistance and feedback for this practicum. Professor J. Geoffrey Bargh who served as my advisor, and my readers; Professor Basil M. Rotoff and Frank S. Kowalski of the Department of Parks and Recreation, City of Winnipeg - who helped initiate this project last May. The bicycle has been studied in great detail by numerous communities and agencies. These groups were very generous in providing information and thus were instrumental in this project. As such I am deeply indebted to these people, each of which is credited in the bibliography. Finally, this practicum is dedicated to my mother for her belief and support since day one.

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INTRODUCTION

During the last 50 years the traffic system in Canadian cities has been developed to exclusively serve the private automobile. Today vast sums of money are allocated to improve existing roadways and create new ones. Supporting this infrastructure has driven many communities to the brink of bankruptcy. In most instances, this has been accomplished by the neglect of alternative modes such as rapid transit, bicycles and pedestrians. However, the problems associated with a transportation system built completely around the private automobile have become staggering - air and noise pollution and congestion beyond the carrying capacity of expanded roadways - have made it imperative to search for alternative means of transportation. Thus it is necessary to devise a solution to the problem, while trying to accommodate the city's transportational needs without destroying the accompanying intricate and concentrated land use.

In response to this problem many cities have turned to the bicycle. In Third World countries it has become the primary source of intra-urban transportation. Conversely in North America, where the population is so endeared to the private auto, goals are more realistically set lower. Such as enticing some automobile drivers to switch to the bicycle. The underlying objective is to reduce congestion by lowering the absolute number of automobiles and make those that remain work harder and more efficiently. As the city increases in territory, the greater the dependency to use the automobile. Concomitantly, as more land is converted into roadways, it effectively reduces significant amounts of land from the city's tax rolls. Therefore, by orienting the city to the automobile, it inhibits the city's ability to collect taxes on land within the municipality's jurisdiction, while reducing its ability to afford the expanding network of roads. Thus many North American cities are developing strategies to lower the demand for automobile facilities. And it is planners that are ideally suited to accommodate this trend with their positions within the city structure and their synoptic view. Plan Winnipeg attempts to heighten the use of public transit and increase the densification of the built area as a means of improving the cost effectiveness of the infrastructure. The Dutch city of Amsterdam proposed, but later rejected, a *borrow a bike* plan in the early 1980s. The city was to have erected municipal bicycle racks and stock them with city-owned bicycles. This would allow any person, to use any bike from any rack with the only requirement of returning it. Proponents of the plan saw it as a method of reducing pollution, reducing gasoline consumption, lowering demand for new roadways, ease traffic congestion and increase the physical health of the population. These examples illustrate how cities can be made healthier and more livable without either, massive rebuilding or an infusion of capital. This practicum explores the possibilities of

enhancing the quality of life in Winnipeg through the use of the bicycle for both recreational and utilitarian purposes.

Chapter One represents the background to the project. It highlights the current urban situation and the trends that are now developing. Thus it is the framework upon which the project is based. Chapter Two provides the focus for the project. It traces both the history of the bicycle and its introduction to Winnipeg. Subsequent sections analyze the present situation of government projects related to bicycle initiatives in the city and also includes an inventory of Winnipeg's bikeway facilities. This includes all major studies and policies which directly affect bicycling. It reflects the government's commitment to the bicycle, not as an alternative form of transportation, but rather as a mode of recreation. It also illustrates the potential for linking together a city-wide bicycle network. If the bicycle is to be accepted as a form of transportation in its own right, it must be thoroughly understood and evaluated. Thus the remaining section in Chapter Two examines all facets related to bicycling in the city. This includes an in-depth financial overview, the health-related benefits of bicycling, the impact of the automobile on the environment and a comparison of the bicycle with the automobile.

Chapter Three, sections one through five, detail the engineering requirements necessary for an efficient city-wide bikeway system. Most examples were drawn from American cities where the bicycle has been studied in far greater detail. The remaining section examines bicycle safety. This includes a thorough examination of medical records and cycling accidents over the last several years in Manitoba. The savings realized in preventing an accident, through monetary, bereavement, job retraining and health-care costs are shown to greatly offset the financial costs of developing a bikeway network and upgrading the safety educational component of any bike plan.

Chapter Four provides an interesting comparison of the bicycling developments attained in other North American cities. The communities chosen, three in Canada and one in the United States, were selected for their uniqueness in accepting the bicycle and their ability to integrate it into the urban fabric. Each provides useful recommendations and lessons, which are applicable to Winnipeg, and are summarized in Chapter Five. They also constitute a portion of proposals put forth for a bicycle plan for the Department of Parks and Recreation.

CHAPTER ONE
BACKGROUND

During the last ten years the sale of bicycles has increased dramatically in almost every developed country in the Western world. In many countries, Canada included, annual sales of bicycles now exceed those of cars. This renewed interest in the bicycle has been sparked by unprecedented rises in the costs of all other forms of transport; increased demand for quick , reliable, door-to-door transport and the growing aspiration for health and fitness. Cyclists in some Western countries, like Holland, are provided with greater consideration, while others practically forget that cyclists exist; again in some, people cycle mainly for recreation, in others, mainly for utilitarian journeys.

Behind this shift in personal travel and recreational habits lie greater fundamental changes. During the past 40 years rapid development has changed the face of the Canadian city, town and countryside. Following the Depression and World War II, there was an abundance of relatively inexpensive energy and rapidly developing technology. These conditions helped sustain unprecedented economic growth. Transportation and land use policies accelerated this growth by encouraging physical development; the conversion of outlying agricultural lands into housing, the construction of new motorways and shopping centres, the separation of industrial, residential and commercial areas and the popularity of residing in rural communities and commuting to work in the city. Local planning departments were rapidly growing to cope with this work. However, there have been significant costs associated with this form of development; the air has been fouled by toxic auto emissions, countless time is spent locked in traffic jams, distinctive landscapes have become monotonous and ugly places, vibrant neighbourhoods have been bisected for new roadways, increasing costs for maintaining and building new roadways, diverse and richly mixed communities have been relinquished and now it is predicted that there will not be enough fuel to sustain the automobiles that society has come to be so dependent upon. The Canadian landscape has been reorganized to exclusively serve the dimensions, speed, and patterns of motorized travel.

Streets have historically played many roles within the development of communities, serving often as marketing and gathering places as well as traffic channels. As urban communities mature, leisure and recreation time increases and the emphasis on cultural and community activities strengthens. This is slowly having an effect on how

residents perceive their town and cities. In addition, the rapid expansion of the suburbs is creating adverse conditions for city residents. Business has flocked to the city outskirts, enticed by the cheaper lands, lower taxes, more lenient building codes and an available pool of nearby workers (Cervero 1986:389). The effects of job dispersal on regional commuting patterns has been striking. Star-shaped commuting paths, long a hallmark of North American cities, are being replaced by a haphazard, scattered dispersion of crosstown, lateral travel. In 1980, for instance, more than 40% of all metropolitan work trips in the United States were suburb-to-suburb compared to 20% between a suburb-and-central city route (US Department of Commerce 1982). If present trends continue, suburban mobility - or rather the lack thereof - may well become the central transportation issue of the late 1980s (Orski 1985:285). As well it signals the end of the age-old distinction between urban and rural forms of human settlements (Blumenfeld 1986:348).

Persons that choose to live in an inner city location possess very different aspirations than those choosing a suburban residence. Inner city sites attract those interested in having a shorter distance to work, school, stores, restaurants, bars, culture and entertainment and friends, conversely, those choosing the suburbs do so for the better quality of environment and potential for homeownership (Friedrichs 1987:77). Changing demographics and social patterns are creating smaller families and households; a spatial separation of function in the metropolis fragments the social relations of work, home, shopping, and literature; the resulting necessity of transportation gives rise to the automobile-dependent population which increases this separation. This leads to a 'mass society' (where) the social content disappears from work, play, the market and even the home (Popenoe 1985).

The traditional response to congestion on the roadways has been to widen existing roads and construct new ones, (Cervero 1986:396) but now many North American communities are realizing that the continual expansion of the roadways will never ameliorate the problems and that they cannot afford to finance this growth. Thus, there has been an increasing shift away from the historical approach to street and transportation planning, to one which mixes land use (Cervero 1986:396; Porter 1985), attempts to revitalize the urban city, seeks more efficient residential/commercial/industrial densities (Cervero 1986:396; Porter 1985; Jacobs and Appleyard 1987:118; Jacobs 1961:357), establishes agencies which attempt to lower traffic levels to postpone new road

construction, such as, transportation system/demand management[1] (Fulton 1988:12), and impose methods of cost sharing new development with private companies, such as, impact fees[2] (Cervero 1986:398; Fulton 1988:14). The ultimate outcome is to improve the livability of the urban environment for city residents through various techniques. These include: reducing the number of trips made by the automobile (Appleyard and Lynch 1974:45), encouraging alternative modes of transportation (Merriam 1986:192), containing the expansion of the city sprawl (Blumenfeld 1986:348; Jacobs and Appleyard 1987:114) and encouraging land use policies which reduce the need for transportation, such as mixed land uses.

Planning is inextricably embedded in the city's structure, the city's response to the marketplace and the city's policies - all of which shape the developmental conditions (Savitch 1987:89). As such, planners have long recognized that much of the planning in North American cities is conducted by individuals - developers, business leaders, elected officials, bureaucrats in other disciplines - that are all far removed from the planning process (Brooks 1988:241). In particular, the urban environment is increasingly in the hands of large-scale developers and public agencies. The elements of the city grow inexorably in size, massive transportation systems are segregated for single travel modes, and vast districts and complexes are created that often make people feel irrelevant. People, therefore, have a lower sense of control over their homes, neighbourhoods, and cities than when they lived in slower-growing, locally-based communities (Jacobs and Appleyard 1987:114). It then becomes necessary to rethink the current approach and devise new solutions to these complex problems. This may best be facilitated through planners, who by their positions in government and access to the decision making process on vital physical/natural questions, may intervene. Planning has historically placed a high value on ensuring a good quality of life for future generations (Tonn 1986:190). The very purpose of planning is to release human abilities, to broaden the field of opportunity, and to enlarge human livability (Merriam 1945:336).

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[1] The Transportation Systems Management had been formed to investigate methods for squeezing a little extra capacity out of a highway system by using ramp meters, signal synchronization, and car-pool matching services. Today, it is more commonly called - Transportation Demand Management. The effort is focused on lowering demand, and it concentrates mostly on techniques for getting cars off the highway during rush hours, either by ride-sharing or flexible work hours. These programs are becoming an integral part of overall land-use planning systems (Fulton 1988:12).

[2] Impact fees are one example of new techniques that communities are turning to, to help finance the gap in local capital budgets. The fee is imposed on the developer, and is used to provide the physical infrastructure, affordable housing and other related services that are made necessary when a developer constructs new commercial or residential projects.

It is in this new approach to traditional planning that the bicycle can play a crucial role. Over the last 50 years the traffic system in Canada has been designed around the automobile, much to the neglect of alternatives such as: rapid transit, the bicycle and pedestrians. However, the problems associated with a transportation network built completely around the private automobile - air and noise pollution, alienation from one's surroundings and congestion beyond the carrying capacity of additional freeways or parking structures - have made it imperative to search for alternative means of city transportation. The bicycle offers many advantages both to the user and to society. It is inexpensive, free of noise and pollution, improves one's health, provides mobility to those previously in need and places the individual in an excellent scale relationship with the urban surroundings (Jacobs 1988:4; Appleyard and Lynch 1974:44). As more people turn to the bicycle it becomes the responsibility of the city planners to accommodate this growing shift in the city's transportation policies. If the bicycle's potential is to be realized, its unique environmental requirements will have to be respected.

Winnipeg is an excellent place for bicycling. The warmer months are well-suited to cycling, the terrain is flat and the city has a relatively dense network of paved roads. With wider use of the mountain bike there has been a steady increase in the duration of the cycling season into the winter months. There are presently 12 active bicycling clubs, whose members participate in rides throughout the year. Each year Winnipeg cycling clubs hold organized rides and rallies, many for charitable causes, which attract hundreds of participants. Bicycle racing has become an increasingly popular sport in Winnipeg. This past summer the city played host to major criterium races which attracted thousands of spectators, like the Coors Cobblestone Classic, the National Cycling Championships at the Velodrome and the Tour of Manitoba. Also, commercial courier companies now employ these quick and efficient operators in the downtown.

However these organized activities barely acknowledge the level of bicycling activity in the city. Along the streets the bicycle is ubiquitous during the warmer months. Thousands of bicyclists take to the streets for recreation, for fitness, for sport and for personal transportation.

And yet, the bicycling environment in Winnipeg is not ideal. Numerous barriers exist, both physical and institutional, which prohibits bicycling from achieving its full potential as a means of recreation and personal transportation. This includes things such as

roadways which are not capable of safely accommodating bicycle traffic, unskilled and untrained bicyclists, and motorists who fail to share the road with bicyclists.

It is difficult to estimate the amount of bicycling which takes place in Winnipeg, but there are strong indications that its use for both recreation and transportation is considerable. And that this use is increasing at a rapid pace. Nevertheless, there is an enormous potential for even further increases in the use of the bicycle as a means of personal transportation.

Most estimates of bicycle use have been developed on a national scale. Cycling, according to a Canada Fitness survey, is the country's most popular summer recreation activity. However, one exception is found in the City of Winnipeg, department of Streets and Transportation report on the travel and demographic trends, where they recorded the number of Winnipeggers who routinely used their bicycle for commuting to work. In 1986, 25 431 trips or 9.5% of all commuters, routinely used their bicycle or walked to work each day.[1] This value is averaged over the entire year, thus the actual number during the warmer cycling months is much greater. It is estimated that as many as three times this number of trips are made for other utilitarian (non-commuting) trips.

National trends in bicycle sales reflect the increased level of bicycle use. Bicycle sales in 1988 are expected to be in excess of 1.3 million units. The Ontario market captures 43% of sales, Quebec and Western Canada 25% each and the Maritimes is responsible for the remaining 7% of sales. It is estimated that Manitoba comprises approximately 100 000 bicycle sales per year.[2] Canadian bicycle manufacturers have indicated exceptional sales this summer, exceeding last years. This was most noticeable with the all-terrain or mountain bike. Manufacturers reported selling out of some models in late May when this event normally occurs around mid-August.[3] The mountain bike has burst onto the scene from relative obscurity in the early 1980s, to where it currently captures over 50% of all sales in 1988. This figure is expected to peak around 60% in the coming year. With its unique characteristic of large tires and excellent braking capabilities the use of the mountain

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[1] City of Winnipeg, *Travel and Demographic Trends 1962-1986*, p.77. Although it could not be discerned what proportion of commuters actually walked and what proportion cycled.

[2] Raleigh Industries of Canada Limited. Mississauga, Ontario. 27 May 1988.

[3] Manufacturers contacted include: Velo Sport Inc., St. Laurent, Quebec; Victoria Precision, Montreal, Quebec; Norco Products Ltd., Burnaby, B.C.; Raleigh Industries of Canada Ltd., Mississauga, Ontario.

bike has enabled city residents to cycle year-round. The breakdown of sales by category includes:

All-Terrain/Mountain Bike	51%
Childrens Bikes (ages 3 to 11)	22%
Racing Bikes	17%
Touring Bikes	9%
Miscellaneous	1%

In Winnipeg the sale of bicycles has continually been outstripping the number of automobiles sold. In 1987 just over 30 000 automobiles were purchased in the city, compared with a province-wide total of 100 000 bikes sold.[1]

[1] Winnipeg Free Press, 4 June 1988, p.11B.

CHAPTER TWO
The BICYCLE in the URBAN ENVIRONMENT

In many North American cities the bicycle has become a legitimate user of the roadways, to the extent where it is planned in conjunction with all the transportation modes employed in the city. It is viewed as a possible alternative for the numerous city residents who car ownership is not feasible. To better understand the unique requirements and capabilities of the bicycle within the urban context, and provide a role for it within Winnipeg, this chapter examines all facets of the bicycle. This includes a financial overview, the potential for a city-wide bicycle network linkage, and as it is to be an alternative to the private automobile, an extensive analysis of the car is conducted which includes a comparison to the bicycle.

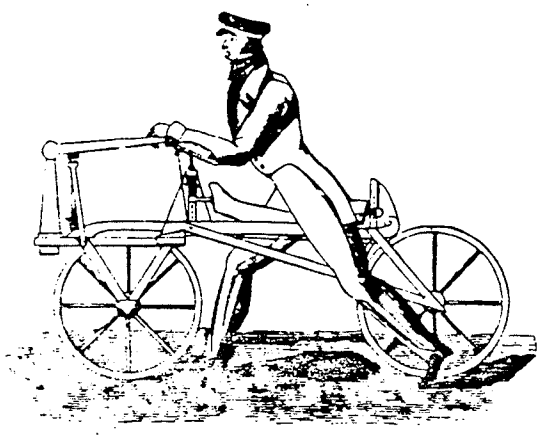
2.1 HISTORY of the BICYCLE

Man had long held the dream of developing a self-propelled vehicle. Many of the earlier versions met with very little success. In 1520 Albrecht Durer developed a four-wheeled machine which was to have supposedly been driven by men. Years later in the early 1660s, a German inventor, Jean Hautsch, devised a carriage that was propelled by two people turning handles and allowed the driver to steer the vehicle. Jean Theson, a Parisian inventor was honoured in February 1645 by the Queen of France, for creating a small four-wheeled carriage that was powered solely by two men in a sitting position. It is debatable whether there exists any connection between these early experiments and the bicycle of today. It was not until the late 1800s that one could see the beginnings of what could be termed the ancestor to the bicycle. When the object became designed for the sole purpose of transporting one person by his own muscle-power and was continuously driven over considerable distances by the legs or arms, does the roots of the modern bicycle become established. This section explores the history of the bicycle, from its conception and its introduction in Winnipeg in the mid-1870s.

The invention of the bicycle is generally attributed to the Frenchman, M. de Sivrac, who in 1791, secured two wheels to a wooden frame on which there was a padded saddle on the wooden cross-member. It lacked a steering mechanism and was propelled by the

feet. As such, it received the name celerifere or "fast feet". Twenty-five years had elapsed when, in 1816, a German inventor, Baron Karl von Drais, modified Sivrac's earlier model by adding a steering mechanism (Figure 1). It became known as the draisine , but was also known as the "walk-a-long" or "dandy horse". It quickly garnered immense popularity.

FIGURE 1 DRAIS' IMPROVED VELOCIPEDE

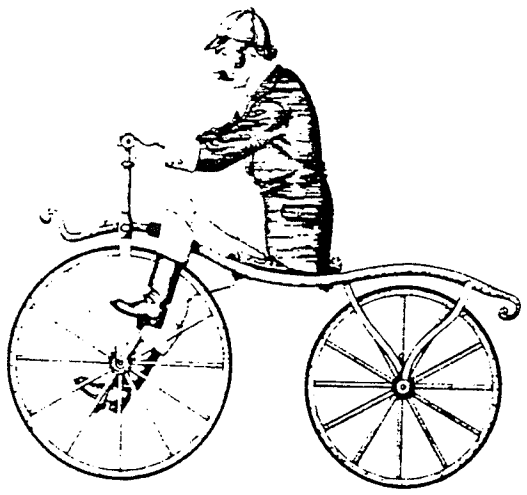


Source:Unknown.

It provided the owner with a mode of transport more convenient, independent and economical than any known before. The inventors of the hobby-horses and four-wheeled velocipedes, (as they were also referred to), saw them as viable alternatives to the railways and stage coaches, then priced beyond what many could afford and which were not in close proximity to the towns and villages where they lived. With their personal transportation they were no longer relegated to the confines of their homes or to destinations only within walking distance. As the draisine increased in popularity alterations were made in an attempt to add some comfort for the users. Some models received leather seats while others had a seat mounted on a spring.

Within fifty years the draisine became equipped with pedals attached to the front wheel, yet this model met with little public enthusiasm. It is widely believed that the accomplishment of adding cranks and pedals to the front wheel was the work of another Frenchman, Ernest Michaux (Figure 2). And it is estimated that he was riding a vehicle of this sort as far back as the mid-1850s.

FIGURE 2 WOODEN MICHAUX 1864:
First of the successful pedal-operated bicycles.



Source:Keith Kingbay, *Inside Bicycling*, p.30.

However, others argue that it was not Michaux but his employee, Pierre Lallement that should be credited with this development. However, it was Lallement who, in 1866, travelled to the United States to receive the first patent for a pedal-powered vehicle in the country. He immediately began manufacturing bicycles[1] in Connecticut as did Michaux in Paris. Competition between the two men was fierce but did provide for technological advances. The Lallement bicycle consisted of a front wheel slightly larger than the rear wheel, and the pedals were attached directly to the front wheel. In the late 1860s rubber tires were added to make the ride more comfortable and quieter. It quickly followed that almost all bicycles became equipped with wire-spoke wheels rather than spokes made of wood.

The Mechanics' Magazine has been published for several hundred years and was the sole forum available to inventors to detail their ideas and innovations. It was here that the history of the bicycle could be found. Thus historians were able to determine the development of the bicycle with considerable accuracy. But, if an isolated inventor failed to get published , he may have been overlooked in cycling history. Such an inventor is thought to be Kirkpatrick Macmillan, a Scotsman who lived from 1813-78. It was not until his death that it was discovered that he had developed two velocipedes.

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[1] The term bicycle was introduced to distinguish a two-wheeled velocipede from all other kinds during the late 1860s.

Macmillan was employed as a Blacksmith in rural Scotland seventy miles from Glasgow, in a village called Courthill. A hobby-horse was brought to his workshop which he replicated and then began to use for his own transport. Unsatisfied with the performance of the hobby-horse he began to modify it with inventions of his own. Sometime between 1839 and 1842 Macmillan succeeded in developing his velocipede that a man could drive without having to touch the ground with his feet and yet created enough momentum to stay upright, thus giving rise to the earliest *bicycle.*

It is unfortunate that the exploits of this inventor did not reach further afield, but it is understandable considering he was far removed from London and situated in the countryside. Undoubtedly there were numerous others who failed to garner wider recognition for their inventions. It was not until the late 1860s that inventors took their velocipedes to the Patent Office for registration.

The bicycle underwent further design innovations during the 1870s. James Starley, an English inventor, modified the Lallement *boneshaker.* This popular model consisted of a huge front wheel that was five feet tall, and in some cases, coupled with a smaller back wheel. Starley's *ordinary* bicycle was exhibited at the Centennial Exposition in Philadelphia in 1876. The large front wheel bicycles were efficient by giving their riders high speeds from their pedal power. The bikes remained cumbersome and one could easily lose their balance on rough terrain. In an effort to get the roads improved and to ascertain equal rights to the road for bicycle owners, as those of owners of horse-drawn vehicles, the League of American Wheelman was formed in 1880. It remains in existence today as a powerful lobby organization for the rights of cyclists. The next major development in the history of the bicycle came with the pneumatic tire, designed and patented by John Dunlop. Within five years the air-filled tire controlled the market.

By the 1890s bicycling mania swept the United States, roughly two million Americans purchased bicycles at an average cost of a hundred dollars. What had been an enthusiast's fad for manpowered machines in the 1850s and 1860s, had now become a craze. Once launched commercially, it very quickly stimulated a new industry, a new sport and a new recreation for thousands of people. A new style of travelling became popular.

Bicycles served to open new avenues for other inventions. Bicycle manufacturers and repairman produced the first motorized vehicles and airplanes, borrowing many ideas

from the pedaled vehicles. Bicycle technology had laid the foundation for their development. Bicycle factories of the 1880s and 1890s were of assembly-line mass-production. Pneumatic tires, brakes, free wheeling, shaft drives, ball bearings - were among the mechanical or engineering advances that owed their development to the bicycle.

In the early 1900s it was possible for almost anyone to own a bicycle or tricycle. There were hundreds of makes and designs developed over a twenty-year period of industrial activity. Each owner had a complete, personalized, private door-to-door short range transport system. In time bicycles gave way to cars and motorcycles as they began to dominate the streets. The post-war affluence in the developed world led to the expansion of suburbia and the car explosion of the 1950s and 1960s. The urban form was rapidly altered with highways and expressways to serve the automobile. The sprawling suburbs were planned with the knowledge that people would be using their cars to travel between them. Bicycle sales reflected this trend as sales slumped abysmally in the developed world. Conversely, the bicycle remained steadfast as the principal mode of transport in the Third World. The 1970s experienced the energy crisis and the early 1980s was marked by yet higher oil prices and increasing interest rates. This all contributed to a resurgence of the bicycle. Statistics in the United States show that there has been a 70% increase in the use of bicycles among adult users over the last four years, rising to a total of 17 million nation-wide.[1] There is every indication that this trend is being replicated in Canada.

2.11 Cycling in Winnipeg

During the 1880s the ordinary bicycle was the unchallenged king of the road. Numerous cycling clubs were set up across North America in response to this phenomenon and Winnipeg proved to be no exception. Velocipedes which date back to 1875, quickly succumbed to the popularity of the ordinary or "penny-farthing" model. The roads soon became congested with cycling enthusiasts, prompting Winnipeg city council to ban the penny-farthing bicycle from the city streets in March 1883. A mass protest by cyclists resulted in two accomplishments; first, the bylaw was successfully rescinded, and second, it spawned the first cycling club in the city, established "for the purpose of protecting the rights of wheelmen on the road".

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[1] Nancy R. Gibbs, Brooke A. Masters and Sam Maddox. "Summer Joy Riding", *Time*, Vol. 132 No. 10. 8 August 1988, p.48.

In 1899 two city bicycle clubs amalgamated into one, the Winnipeg Rovers. As a coincidence, it was during this year that the city initiated the issuing of bicycle licences. Several years later the St. Boniface and the Seven Oaks clubs were formed. By the 1900s bicycling popularity reached considerable proportions. Exclusive cycling paths were built that led to the city outskirts. These included; cycle paths along Portage Avenue, on both sides of the street car tracks to Silver Heights (Deer Lodge), to Elm Park on Pembina Road and along the East side of the Red River - South of the Norwood Bridge. The paths were built and maintained by subscriptions from the 2 000 members of the Cycle Path Association. Problems arose dealing with the cost of constructing and maintaining cycle paths. The association believed that this cost should be derived from bicycle licences. Previously the revenue generated from the sale of bicycle licences had not been going exclusively to the betterment of the paths.

At the turn of the century the price of bicycles became cheaper and cycling began to boom. Concomitantly the *low-wheel* or *safety* bike began replacing the penny-farthing bike as the popular choice. Over time the image of the cyclist became tarnished. The article, "Hints to Bicyclists" appeared in the 21 April 1900 edition of the Winnipeg Tribune. The article explained how the bicycle speeder or scorcher was bringing the cycle fraternity into disrepute. At the time there existed a city bylaw that restricted a bicyclists' speed to 8MPH, which the scorcher had a penchant for exceeding. This article serves as an example of how misunderstood the bicycle had become and the apprehensive nature of the public. The article continued by debating "whether it was the lowering of the handle bars that caused one to scorch, or that the desire to scorch made one lower their handle bars". It also deplored the use of low handle bars by lady drivers saying that they resemble nothing more than a number of wooden figurines guaranteed to break if they are interfered with. Some of the better known racing cyclists from Winnipeg included; Dolph Graham, K.J. Johnston, Dan Bain and Billy Lockhart.

At the turn of the century the cycling industry in North America hit a slump. Sales fell from 2 million units/year to one-quarter million units/year. The First World War brought an even further decline for the bike but a boon for the automakers. In the early 1920s attention was focused on Henry Ford who used the cyclemakers' technique of mass-production and mass-sales to sell 15 million Model Ts.

By 1940 additional bicycle bylaws were in place to stem the growing number of cyclists who operated their bicycle in a poor manner. City police were now empowered to;

impound bicycles on second traffic offences; for certain offences (for example, operating a bicycle at night without a light) the parents of the offender becomes party to the offence and were subsequently punished, in addition, the police pressed the city to use licences that were distinguishable from a distance as they believed it would greatly discourage poor behaviour on roads if they became easily recognizable and thus reportable, and as well the police undertook a vigorous campaign for bike safety education.

To deal with these bylaw infractions Judge F. Hamilton operated a "bicycle bylaw court" where he adjudicated over frequent offences, such as, failure to ride; single file, as close to the curb as possible, or operate without a light at night. In two and one-half months Judge Hamilton handled over 1 000 cases. The bicycle was steadily increasing in popularity. In 1935, 9 664 bicycle licences had been sold, this figure rose to 22 863 by 1941 outstripping the number of cars registered in the city by more than 1 500. This trend away from the car was short-lived as it was the result of war time restrictions and regulations that covered the use of motor vehicles, rubber and gasoline. The city fathers acknowledged the comeback of the bicycle in Winnipeg and parking stands were installed at streets corners , like Donald and Portage, and Smith and Portage. The proliferation of bikes prompted the City police to initiate a new stolen bike recovery program. The program proved successful, of the 796 bikes stolen in 1945, 780 had been recovered. The key to the success was the use of licencing the bikes. At the time of registration the bike had to be present and the serial number verified. This effectively discouraged theft because the police also:

i Distributed daily the serial numbers of stolen bikes to all points between Kenora and Edmonton,

ii Police inspection of unregistered bicycles, and

iii A clause in the Provincial Highway Traffic Act that makes it a criminal offence to tamper with a serial number.

In 1963 the Winnipeg Cycling Club was founded. Planning agencies in Winnipeg began exploring the possibilities of creating bicycle routes throughout the city. This was prompted by city residents who advocated that routes were ideally suited to parks, along river banks, around the perimeter highway and permitting bicycles the use of certain streets while limiting automobile traffic. In 1970 the Churchill Drive Park path was established. Two years later the Provincial highway department received a report on bicycling conducted by the University of Winnipeg Athletic Department. The study concluded:

- All bicycles should be banned from all Manitoba highways after dusk;
- Special paths be built for the exclusive use of cyclists;
- Establish a central bicycle registry;
- Create a uniform licencing policy; and
- Provide "bike highways" - highways with shoulders paved with lower quality asphalt for use only by bicycles.

In the following spring Winnipeg's transportation department announced an ambitious 15 year program to construct 145 miles of bicycle paths throughout the city. The network would consist of 25 loops, ranging in length of less than one mile to over 10 miles, allowing a cyclist to chose the route that best suited their expertise. This grandiose scheme was to link residential areas, schools, playgrounds, parks and landscaped riverbanks. If the initial circuit proved to be successful, the remaining loops were to be implemented. The test route was an 8 mile track that ran through Assiniboine Park and the Tuxedo wilderness area. It was completed in the summer of 1974. Weeks later a test count was conducted and recorded over 1 000 cyclists in a three and one-half hour period. However, this was to be the only route constructed from the program.

Other developments in cycling include: the construction of the Winnipeg Cycling Velodrome built for the 1967 Pan-American games, replacing the St. Boniface Velodrome lost during the post-war construction boom; the closing of Wellington Crescent to cars for the exclusive use of bicycles, pedestrians and joggers. When it first opened in August 1973 over 3 000 cyclists used the opportunity that Sunday afternoon. The following summer there was an average of 2 000 cyclists each Sunday. With this overwhelming success the city has continued this practice of Sunday cycling each year and expanded the idea to nearby Wolseley Avenue in June 1979. In September 1973, the Provincial highways department announced the establishment of an 11 mile section of Henderson highway as a cycling route, marking it with appropriate signage. It was intended to gauge cyclist response before the government embarked on any major undertaking, such as exclusive bicycle paths or designating additional routes. By mid-November, when the route was closed due to inclement weather, it was estimated that up to 200 cyclists used the route per day.

The current inventory of bicycle facilities in Winnipeg include:

Roadway Facilities
- bikeway lane along Henderson Highway;
- Sunday paths, closing city streets, which includes portions of Wellington Crescent; Wolseley Avenue; Scotia Street; and River Road.

Marked Cycle Paths
- Assiniboine Park and Tuxedo Golf course;
- Churchill Drive Park;
- Windsor Park Golf Course.

Pedestrian/Bicycle*
- Sturgeon Creek Path;
- King's Park Path;
- Steve Juba Parkway;
- Promenade Tache;
- Kildonan Park Path;
- Bunn's Creek Park Ski Trail Path.

2.2 ANALYSIS of GOVERNMENT BICYCLE INITIATIVES

In Winnipeg the development of bicycle facilities has mainly been confined to the construction of paths within some of the city parks. This trend will continue as the department of Streets and Transportation considers on-street cycling routes which serve bike commuters, to be a low priority. As such this section provides an overview of the government studies which explore the potential of the bicycle in Winnipeg and their recommendations for future bicycle projects. In addition the most recent government initiatives to improve cycling conditions within city parks are also examined to determine the potential for bicycle path linkages to create a city-wide bicycle network.

2.21 Winnipeg Bicycle Route Study

In April 1973 the City of Winnipeg's Transportation Division, in collaboration with the Planning Division, produced a report titled, *Winnipeg Bicycle Route Study*. This report was initiated by the Committee on Works and Operations in response to the overwhelming popularity of the bicycle. This trend was especially prevalent with respect to the recreational cyclist. As a result bicycle sales in Canada almost doubled during the three years prior to the study being published. The purpose of the study was to determine the feasibility of providing a system of bike paths within the City. Further investigations also

* Some of these paths are used by cyclists but they vary in composition. They include dirt, asphalt, wood, paving stone and gravel surfaces.

examined items such as general bicycling safety and the location of such paths. Numerous Canadian cities were examined, but Calgary and Ottawa were chosen as case studies as they were seen to be very progressive in their development of bike facilities.

Citing problems beyond the city's control, which included the inherent problems associated when motor vehicles and bicycles are blended together in the transportation network, the committee concluded that there was little that could be done to alleviate the conditions for the commuting cyclists and thus, planning emphasis should be placed on the development of bicycle routes oriented towards recreational use. Thus recommendations focussed on the creation of a bicycle network which would incorporate, where possible, bicycle paths - pavement that prohibits motor vehicle traffic and is most often segregated from the roadway and, bikeways - which are well-identified, suggested cycling routes that utilize existing vehicular roadways where cyclists would share the roadways with other forms of traffic. The study recommended a bicycle route network for the City of Winnipeg that consisted of 145 miles of bicycle paths and bikeways situated in interconnecting loops interspersed throughout the city.

The project was to have been implemented through various stages, with the 8 mile Assiniboine Park circuit (bisecting Assiniboine Park, along Wellington Crescent to Lindsay Street and along Taylor Avenue, then returning to the Park) being the first step. This was to be a trial project to determine citizen demand for such a facility. If it proved successful the remaining loops were to have been constructed over a ten to fifteen year period. Unfortunately there were no additional routes undertaken.

Secondary recommendations included a network of bicycle routes be adopted in principal as a guide for future planning purposes, and Community Committees review the suggested routes within their areas and submit comments and suggestions for improvements to the system.

2.22 Plan Winnipeg

Plan Winnipeg was formulated in 1980 and examines the 25-year time frame for the overall residential, parks and recreation, and industrial development in the city. The plan dictates development until the turn of the century. It is designed to help promote high-density, family housing in the downtown area, the rehabilitation of inner-city neighbourhoods and parks and recreation services in the core area. The thrust of the plan is

for containment and revitalization. The plan's "least-cost" approach is formulated to minimize the cost of new development to the city.

The Parks and Recreation component of Plan Winnipeg is predicated on five research reports, conducted by Douglas D. Paterson and Associates Ltd., for the Winnipeg Plan Review. They include: 1 *A Review of the Study Process*; 2 *Public Participation and the Parks and Recreation System*; 3 *History, Attitudes, Philosophies, Criteria and Standards*; 4 *Inventory and Analysis - Excesses and Deficiencies*; and 5 *The Recommended 25 Year Conceptual Master Plan.*

The first report, *A Review of the Study Process,* outlines the study objectives, timing and methodology that was followed. Furthermore it also identifies areas where additional investigations are necessary if Winnipeg is to realize an Open Space System. The data collection stage included a series of questionnaires that were administered to the department of Parks and Recreation. The questions were designed to solicit staff opinions on a host of topics. These included their idea for:

Standards for the various levels of parks;
Problems with the Parks and Recreation system;
Goals and objectives for the upgrading of the system;
Changes needed to the existing Parks policy;
Future events that will impact the system; etc.

There were numerous answers provided, but a brief synopsis of those relating to bicycling and similar themes included:

- Develop linear parks and bike trails which complement major traffic patterns and yet provide a natural and safe barrier;
- Trend towards a city-wide cycling, jogging and cross-country skiing emphasis;
- More pedestrian and bicycle systems that relate to or tie-in to community centres, shopping areas, etc. should be developed;
- An overall recreational circulation system should exist which would link pedestrian and cyclist traffic to parkways;
- Trend towards energy conservation;
- End of fossil fuels will necessitate drastic park changes;
- Make riverbanks more presentable for use by the general public in Summer and Winter.

The second report, *Public Participation*, is a compilation of ideas and opinions expressed by the participants, and a synthesis of these ideas with some indication of the

similarities. The purpose of this report was to broaden the level of input for the planning task of the Winnipeg Development Plan Review. Feedback was provided from over 160 participants that took part in the 13 meetings. Those that offered opinions came from the general public, district planners as well as special interest groups, who were thought to be able to provide a unique perspective, with their views of the system and its future. Groups ranged from organizations like Senior Citizen associations to the Manitoba Sports Federation.

There were numerous and varied responses that covered the broad spectrum of activities under the auspices of Parks and Recreation. Answers were then collated and ranked by perceived importance. Those that pertain to bicycling were found to rate as very important for some groups, to moderate and less important for others, but yet no group completely neglected it. The following list provides a brief glimpse of responses that were rated high by participants and dealt with bicycling.

C.4 Provision of Facilities -

- Bike paths, walking paths and trails should be provided linking schools and natural areas.
- There are not enough hiking and bicycling trails.
- Bicycle paths should be provided rather than four lane highways. These would be used for trips to work as well as for recreation.
- There is a lack of safe and efficient bicycle paths - paths that get people where they want to go.

C.5 Provision of Programs -

- Parks and Recreation facilities should be multi-purpose and for the whole family.

The initial two reports illustrate the immense public support for the provision of bicycle facilities in the City. However, in the nine years that have elapsed since the introduction of these studies, conditions have failed to improve for cycling enthusiasts. Winnipeg's construction of bike facilities has been relatively sparse, especially when one compares it to the progress in Calgary or Ottawa, which Winnipeg had used as case studies in the 1973 Bicycle Route Study. Both cities have undertaken the commitment to improve conditions for bicyclists by providing numerous kilometres of bike paths for the recreational cyclist and on-street bike lanes for the commuter.

Report 3, *History-Attitudes-Criteria-Standards,* examines the history of parks both in North America and in Winnipeg. It explores the attitudes and concepts related to the

provision of open space. From this criteria, standards are established for an open space system in Winnipeg.

It was noted in this report that at no time during the history of park development in Winnipeg has there been a concerted effort to create a system of parks and open spaces at any level. Furthermore, open space has not been used as a major element of planning to give order and structure to the landscape. The remaining sections of the report attempt to identify a basis for determining the nature of parks, recreation and open space. As a result, numerous recommendations are put forth dealing with neighbourhood, community and district level open space, which are encapsulated in report 5, the *25 Year Master Plan.* The report recognizes that a successful open space system for Winnipeg should provide for:

> ...pedestrian and bicycle trails throughout the city linking various neighbourhood, community and district facilities with one another, the work place and downtown. The notion of linking activities, spaces and places provides the resident with a more intimate knowledge of his community and city, an image that often differs from his understanding of the city as seen from an automobile.(Paterson 1980:41 report 3).

A theoretical community as outlined in the report, would contain 28-30 000 people and be developed around a distinct physical and geographical image. Furthermore, it would be bounded by major arterial routes on all four sides and would focus on a major collector route. Suggested standards and facilities include a multi-purpose 40 acre school-arena-park site. Situated within it and connected to the surrounding communities would include the provision for a 1 acre **exercise trail.**

An evaluation of the status of the Parks and Recreation system, including an examination and itemizing of the excesses and deficiencies, constitutes report 4. The report highlights the system's shortcomings and calls for the infusion of capital to improve current facilities and create new ones.

Although this would create the ideal situation, it is unlikely to occur given the budget constraints effect on priorities. But the report does illustrate the trend towards developing a wider variety of recreation activities, leading away from sports-related activities. Nonetheless, sports-related activities still predominate. Passive, individual and nature-oriented activities tend to be less accessible to the general population.

The sports-related activities are aimed more at organized or group activities, such as softball or hockey. There does occur however a constant similarity in the appearance of and the degree, to which these basic sports-related activities are provided. Furthermore they are single-purpose oriented, and once the activity has been completed there is nothing to encourage that participant to remain in the park or space. Outside of the major District-City parks, there are few places within the City where an entire family may recreate together. It is also important to note that major shifts can be expected in the general parks and recreation programs as trends lead away from group competitive sports to individual pursuits. This can be attributed to the increased emphasis on physical fitness and life-time activities and with an aging society.

The previous four reports served as the basis for the fifth report, the *25-Year Conceptual Master Plan.* It incorporates data, ideas, recommendations and plans as detailed in the earlier investigations. It provides a general time frame to the year 2005 that allows for the implementation of the major components of the plan.

The Master Plan recommends the long-term creation of a 250 mile pedestrian-bicycle system divided into Ways, Trails and Cross-Cuts. The Ways are looped systems serving as the hub of the system and having as their focus the junction of the Red and Assiniboine Rivers. Further, the Ways act as a circular linkage system that collects and distributes pedestrian and bicycle movement throughout the City and acts as a focus to the system. The Trails lead from the Ways out to the surrounding city landscape. The Cross-Cuts connect the Trails at various points in the extended landscape. All three linkages relate to various neighbourhood, community, district and city-wide activities and open space.

The 250 mile linkage system is predicated on the creation of two Ways, 20 Trails and 14 Cross-Cuts for a suggested expenditure of $10 Million dollars. In addition, it is recommended that the city spend $45 million dollars towards Rivers, Streams and Creek bank acquisition to establish an urban riverbank park in the downtown.

The review of the Greater Winnipeg Development Plan by Paterson and Associates, Ltd. provided the City with a comprehensive background study that is necessary in the policy making process. The Parks and Recreation Department formulated Plan Winnipeg's recreation component detailing the objective policies and programs that will serve as guidelines to administer the newly defined open space system.

The creation of recreational trails is initiated under the subject heading, *Open Space Linkage* system. Of equal importance to the existence of parks is their accessibility to the people they were designed to serve. The growth of the city over the past decades has only increased the inaccessibility of major parks to much of its users. The accessibility of all park sites could be greatly improved as the potential exists within the City of Winnipeg for a linkage system which could provide pedestrian and bicycle access between home, work, park sites and other facilities.

The linkage system will allow the citizens of Winnipeg to experience the city from a different perspective. The linkage system itself may also become a facility for activities; a focus for events such as marathons and bicycle rallies. The underlying policy is that the city shall provide an open space linkage system for pedestrian and bicycle trails throughout the city in order to link various neighbourhood, community and regional facilities.

The utilization of river banks offers an excellent opportunity for revitalizing the city's image. The rivers provide invaluable aesthetic amenities and visual impacts not otherwise available in a flat urban landscape. As linear features, they create a strong focus for major linkage systems. The rivers and creeks are also an integral part of Winnipeg's historical heritage and offer potential as a recreation feature to the populace.

Plan Winnipeg has established the policy that the city shall create a river bank linear park system along and/or adjacent to Winnipeg's river banks. The objectives are:

- To integrate the river bank parkway system with neighbourhood, community and regional parks;
- To protect, preserve and enhance views and vistas;
- To protect and preserve environmentally sensitive areas;
- To provide access to the water to allow people to pursue a wide range of water-oriented activities.

The linear park system is to be comprised of actual river bank properties and lengthy sections of quiet residential streets closely paralleling the rivers. Where roadway opportunities such as Wellington Crescent, Scotia Street and Kildonan Drive exist, river banks will not be required, thus acquisition will not be a high priority. However, where adjacent roadways are major thoroughfares, priority will be placed upon acquisition of river bank property. This policy is perhaps more cost effective but it ignores the quality of the roadway. Streets such as Scotia are poorly chosen cycling routes as they have many faults that inhibit a cyclists enjoyment of travelling. Scotia street is inadequately maintained to be

a cycling route, it is narrow with numerous potholes and debris scattered about, drainage grates are situated parallel to the roadway, and it is a bus route for a portion of its length. In addition to being recommended as a bicycle route, it is also recommended as a scenic drive/image route for automobile drivers. Uses that the city deems not incompatible but which do impede a cyclists enjoyment of the route.

2.23 Core Area Initiative

The Core Area Initiative was signed into effect on 29 May 1980. This tri-partite project is unique in Canada as it draws on the resources of all three levels of government, contributing equally to the five-year $96 Million dollar budget. The CAI's mandate was to plan, co-ordinate and implement projects to revitalize Winnipeg's inner city and improve economic opportunities for its residents. Programs undertaken were: Employment and Training; North Portage Development; Neighbourhood Main Streets (opportunity for businessman to cost-share improvements in their operations); Housing; and Historic Winnipeg (revitalize and redevelop historically significant buildings). The effort yielded nearly $80 Million dollars in private funds and $170 Million dollars in complementary public funds. All of which had been directed to the downtown, creating a powerful impetus that had previously been missing. The strong support for continuing the program translated into a second Core Area Initiative agreement. Similar to the original, this project will run for five years, expiring in March 1991. Two projects which are of relevance to trail development include: the East Yards Redevelopment and Riverbank Enhancement. The total budget of the second agreement is $100 Million dollars.

C.N.R. East Yards

With the emergence of Winnipeg, the Forks quickly gained in prominence as a meeting place. The junction of the Red and Assiniboine Rivers served as a rendezvous, settlement and transportation centre for the exploration of the Canadian West. The site was home to native activities followed quickly by the development of fur trading forts, with water and trade links extending in all directions. The introduction of the railway meant the mass immigration of new cultures and the transformation of Western Canada.

More recent history has seen the clearing of rails this past summer. The East Yards project is run by the Forks Renewal Corporation, a separate body funded by $20 Million dollars from the CAI. It was set up to oversee the development of the 93 acre site. The first project will be a 9 acre National Historic Park located at the junction of the Red and Assiniboine Rivers. It will be an Interpretive Centre detailing the national historic

significance of the site and run under the auspices of Parks Canada. Additional components of the site will include an open farmer's market; an entertainment and performance centre; and a marina. Running throughout the entire site will be a new riverside walkway. The former CN rail bridge at the perimeter of the Forks site will be transformed into a pedestrian walkway that will hook up with a new riverside walkway, enabling cyclists to travel through the Bonneycastle and Stephen Juba parks to the Forks National Historic Park. A development plan is currently being formulated at the Spence/Memorial Community Improvement Association that proposes the creation of a path along the Assiniboine River, linking the Forks to the Legislative grounds.

Riverbank Enhancement Program

The program is designed to revitalize city riverbanks by creating community access to areas previously inaccessible during the summer and winter months. It will serve to complement a lot of the activity in and around the Forks. The $5 Million dollar riverbank enhancement program is to begin in the summer of 1988 and is expected to be completed within the next two or three years. Among the plans are a $2 Million dollar walkway along the North edge of the Assiniboine River linking the Forks to the Provincial legislative grounds, a pedestrian walkway along Lyndale Drive, a conservative area along the Seine River, improvements to the Alexander Docks near the Forks and the development of a number of stops between the downtown and St. Boniface. Each project will carry an interpretive plaque explaining the area's historic or geographic significance. It is anticipated that the Core Area Initiative will provide funding for continued work on the river trail project.

2.34 Canada-Manitoba Agreement: Red River Corridor

Regional parks and recreation began to emerge during the 1950s in response to the boom of suburban development and the great pressures it placed on the resources of the region. It was not until the late 1950s, after the introduction of a Provincial Park system in Manitoba, that attention was directed to regional recreation development for the City of Winnipeg. Fifteen years elapsed before the Red and Assiniboine Rivers garnered any attention and their role as the focal point for regional recreation and tourism defined. In 1977, Beaudry Farm on the Assiniboine River was acquired by the Province for regional recreational purposes. This commitment was enhanced when, in 1978, the Canada-Manitoba Agreement on the Red River Corridor (ARC) was signed into effect. It initiated specific developments along the Red River Corridor (Figure 3). The agreement was an attempt to satisfy the increasing demand for a co-ordinated approach to heritage

conservation and the provision of outdoor recreational opportunities. This will have important implications for the continuation and linkage of bike paths throughout the entire park system to create a city-wide recreational network.

With the formation of the Metropolitan Corporation of Greater Winnipeg in the early 1960s, downtown Winnipeg began to receive specific attention. The Downtown Development Plan initiated steps in an attempt to link the city core with the rivers through the creation of a continuous park along the Assiniboine River between the Legislative Buildings and the junction of the Red and Assiniboine Rivers. However these efforts were, at best, partially successful. To date, only a portion of the riverbank park has been developed but plans are being formulated that would eventually see this link being completed.

The general objectives of the Red River ARC Agreement are:

i To identify, preserve, interpret and develop the natural, historical and scenic heritage resources of the Red River Corridor, and

ii To increase the educational, recreational and cultural benefits from the use of these resources for the benefit of the people of Canada, in general, and for the residents of the Province of Manitoba, in particular.

The Red River has been a focal point in Manitoba for hundreds of years whether for transportation or recreational endeavors. As such, it possesses an enormous wealth of opportunities to enrich the lives of Manitobans. The Corridor is easily accessible to the two-thirds of the population of Manitobans who reside in the immediate vicinity, as well as the majority of tourists who visit the Province. The first agreement outlined $13 Million dollars in proposed projects. Sites were chosen that offered immense potential as Resources and/or Recreational opportunities. Projects along the Red River Corridor extend from the Trappist Monastery Project South of Winnipeg to the Netley Creek project North of Selkirk. Within Winnipeg there are eight projects totalling approximately $6.6 Million dollars. These include:

- **THE FORKS VISITOR INTERPRETIVE CENTRE**

To be built to the South of the Provencher Bridge along the West bank of the Red River. The Centre is intended to provide a major interpretive facility to relate the role of the

Forks in the opening of the Canadian West and to orient visitors to the resources and opportunities within the Red River Corridor.(Figure 3).

• THE FORKS RIVERBANK PARK

The Forks Park is to extend from the Norwood Bridge to the Provencher Bridge. And the modification of the old C.N.R. bridge to facilitate pedestrian traffic. Original plans call for the park to follow the river extending into the C.N.R. lands, then tapering down to become a linear riverbank park North of the Provencher Bridge. The proposal would include the formation of bicycle trails through the North and South points of the Forks; the creation of an interpretive garden at the Upper Fort Garry Gate; and a major docking facility and promenade developed to provide access from the Corridor to the Park and Visitor Centre. The development of the Forks Riverbank Park Project is intended to create a scenic recreational area that will complement the Visitor Interpretive Centre, provide access to the Corridor and form the City's urban edge on the river. (Figure 3).

• DOWNTOWN RIVERBANK LINEAR PARK

The purpose of this project is to provide a linear riverbank system in downtown Winnipeg linking Alexander Docks with the Visitor Interpretive Centre at the Forks. As well, access would be provided to the Old Market Square district along Bannatyne Avenue. The park is to include an amphitheatre, Plaza, Boardwalk and Pedestrian/Bicycle trails. (Figure 3).

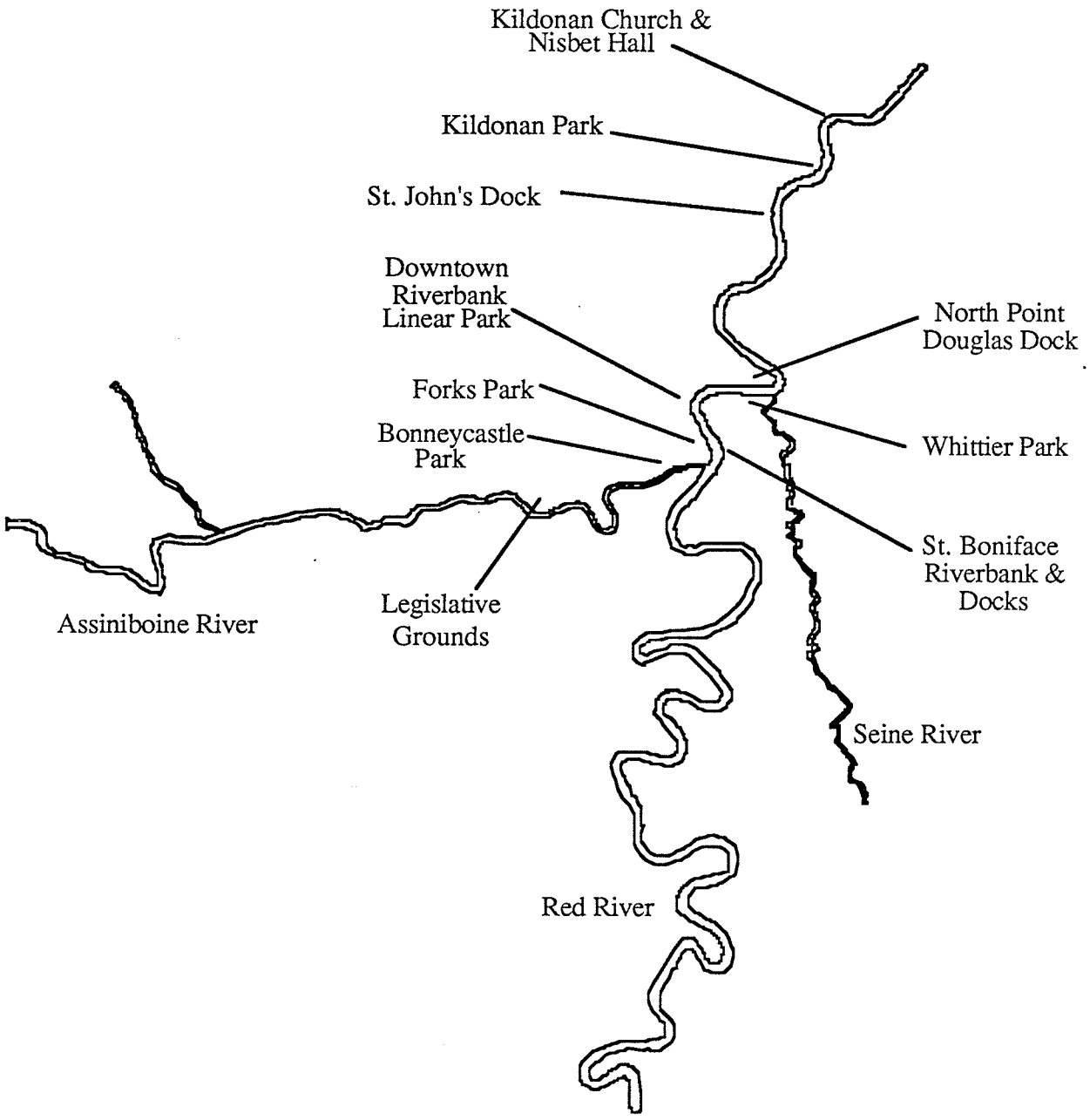
• ST. BONIFACE DOCKS and RIVERBANK

The project is a linear riverbank park along the East side of the Red River extending from the Tache Promenade to Whittier Park. The park is to provide a significant opportunity for visitors to examine the historic, cultural and recreational resources in this area. Project components include: a major dock near the Basilica to allow tour boats to land visitors for walking tours and visits to historic sites such as Riel's grave and the Grey Nun's Museum; provision of pedestrian/bicycle trails; and the construction of a secondary dock at Whittier Park. (Figure 3).

• NORTH POINT DOUGLAS

An outdoor interpretive display and dock is to be established upstream of the Louise Bridge in the community of North Point Douglas. Being settled in 1812 by the Selkirk Settlers, this neighbourhood has the prestigious honour of being Winnipeg's oldest. The display is intended to detail the historic sites and outline a self-guided tour. (Figure 3).

FIGURE 3 A.R.C. RED RIVER PARK FACILITIES



Source: A.R.C. Management Board, *Red River Master Development Plan,* 1981.

• **KILDONAN PARK and ST. JOHN'S DOCK**

Docks are to be constructed at the two Red River parks that would increase the opportunity for public access to the Red River and to provide access to public parks for people travelling on the river. These recreational and pleasure spots are generally inaccessible to Corridor traffic. (Figure 3).

• **KILDONAN PRESBYTERIAN CHURCH and NISBET HALL**

The Kildonan Church is located at the foot of John Black Avenue on the Red River. It was constructed in 1851, some forty years after the arrival of the Selkirk Settlers. Nisbet Hall was built in 1865 near the Church site. It became the birthplace of higher education in Manitoba. It was associated with the formation of Manitoba College, which is one of the three founding affiliates of the University of Manitoba. (Figure 3).

• **BOAT BUS PROJECT**

The project is designed to provide better public access of the Red River and permit the appreciation and enjoyment of the river as an important feature in the development of Winnipeg. This would be facilitated through the development of a system of water transportation intended to provide low cost public access between destination points along the river. (Figure 3).

These recent government studies illustrate that the city views the bicycle solely as a 'vehicle' for recreational pursuits. Bicycle proposals are limited to park sites and, at present, there appears to be no willingness by the governments to improve the conditions for the commuter cyclist whose most direct route for the journey to work incorporates the always congested arterial streets.

2.3 AS A MEANS of TRANSPORTATION

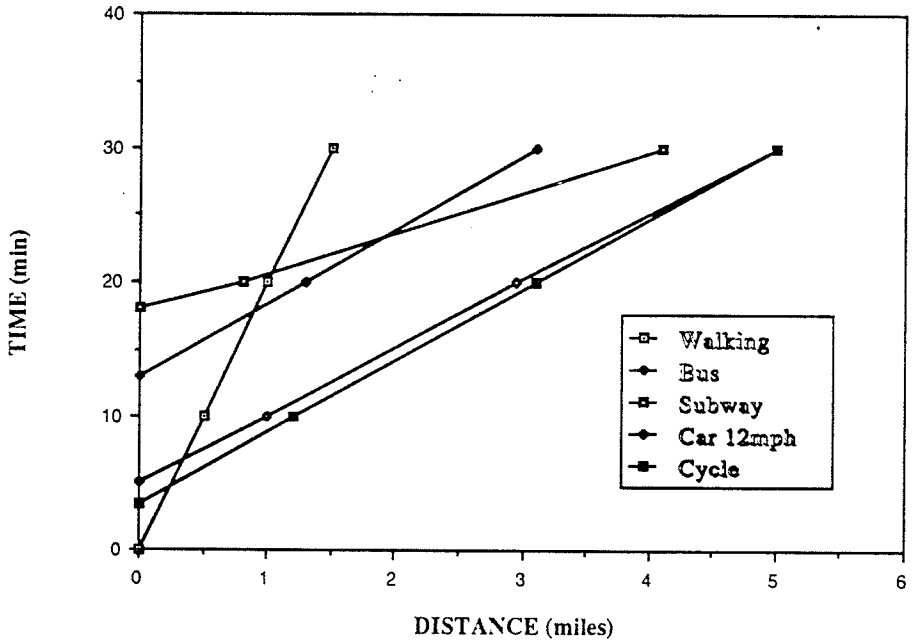
2.31 Introduction

Within the urban infrastructure the bicycle possesses many advantages over public transportation, private vehicles or walking. Bicyclists are able to travel long distances, (and in most cases arrive more quickly), consume no fossil fuels, provide door-to-door service, operate free of pollution and yield an excellent source of exercise. However, there does exist constraints to their use in the city. The bicyclist is exposed to weather and pollution, becomes vulnerable as he/she is compelled to compete for space with faster moving automobiles, expends own energy to get places and is limited by the terrain. With its many positive attributes it is important that the city formulate transportation policies that incorporate the requirements and capabilities of the bicycle into the overall plans. To

accomplish this it is necessary to better understand the bicycle and its role within the city. To this end, this section provides an examination of the factors which influence bicycle use and studies the impact of the automobile on the environment and compares it to the bicycle.

The distance that can be travelled is quite often the most restrictive factor in bicycle transportation. This is not because of the energy required but rather the time involved in covering the required distance. Under most urban conditions a cyclist could ride a four mile door-to-door commute in less time than a motorist, subway user or bus traveller. (See Figure 4). The bicycle is a quick means of urban transport. Door-to-door journey times are not complicated by walking to and from car parks, bus stops, railway stations or searching for available parking stalls.

FIGURE 4 TIME vs TRANSPORTATION MODE



Source: Mike Hudson, *Bicycle Planning Policy and Practice*, p.5.

Most journeys to work are well within the range of the average cyclist. Table 1 illustrates the motor vehicle trip lengths data from the 1969 FHWA National Personal Transportation Study.

Table 1 Motor Vehicle Trip Lengths

MILES	% of TRIPS	% of MILES
0 - 5	54	11
6 - 9	20	14
10 - 15	14	19

Source: FHWA National Personal Transportation Study, 1969.

Table 2 shows the length of commutes of the 37% of the respondents to *Bicycling* magazine's 1980 subscriber study who commute. The average trip length was 4.7 miles.

Table 2 Cycle - Commuting Trip Lengths

MILES	% of TRIPS
0 - 2	16
2 - 5	43
6 - 9	26
10 - 14	10
15	+5

Source: *Bicycling*, Rodale Press, Inc. Emmaus, PA. 1980.

With the post-war expansion of the cities many residents left the downtown to take up residency in the outlying suburbs. Thus, for many citizens it may require a 10-mile commute to get to work. Over the range of 5-10 miles the travel time increase for cycling becomes significant, and many persons would not care to expend the additional energy required to get to and from work.

2.32 Financial Overview

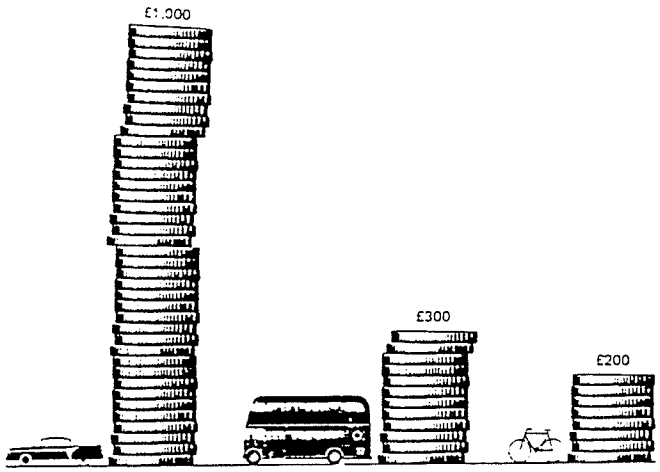
The decision to rely on either the bicycle, public transport, private motor vehicle or a combination of all, will not be made purely on the basis of monetary costs, but in conjunction with considerations of necessity, convenience, reliability, effort, time and therapeutic value. Their relative importance is closely linked to lifestyle. Isolated rural households will find a private motor vehicle essential for all trips. A city dweller, on the

other hand, may discover that public transport will satisfy all requirements for leisure purposes or to make utilitarian trips easier.

The costs to be considered are comprised of:
Depreciation - the annual loss of value of the mode purchased.
Fixed running costs - taxes, insurance and storage.
Journey-related costs - fuel, maintenance and parking.

On this basis, the average total cost per annum for a user travelling 80 km per week for utilitarian journeys (work, shopping and personal business) is currently higher for a car than public transport and lowest for a bicycle. Figure 5 provides a financial comparison of the three modes using examples from the United Kingdom.

FIGURE 5 TOTAL COST per YEAR for 80 km/week



Source: Mike Hudson, *Bicycle Planning Policy and Practice*, p.26.

For a particular journey the decision to use either mode becomes a function of the journey-related costs. Public transport journey costs generally exceed those of a car journey, with the bicycle again being the cheapest. (Figure 6). Changes in the cost of a particular mode come about as a result of variations in:

Labour costs,
Material costs,
Fuel costs,
Maintenance costs,
Taxation.

FIGURE 6 EXTRA COST per ADDITIONAL KILOMETRE

Source: Mike Hudson, *Bicycle Planning Policy and Practice*, p.26.

People change their mode of transport most often,when there is a noticeable shift in the relative cost of the other modes. Such changes are usually more marked if the change in relative costs is sudden, for example, the increase in both bicycle and motorcycle use following a sharp rise in fuel costs. The cyclists uses 23 kilocalories of energy per passenger mile whereas a car uses 630 kcal/passenger mile.[1]

The bicycle is a simple piece of machinery, which everyone can understand, almost anyone can learn to ride, and most people can afford to buy and run. No other means of transport combines this intrinsic simplicity and availability to the whole community. For certain groups of people, such as the youth, the poor and the elderly, the bicycle may be the only means of transport which is available, particularly in urban areas where the provision of transport may appear to be good, but it is not readily available to them for practical or financial reasons.

2.33 Human Performance

Most of the limits of bicycle performance are determined by human factors. For a particular person, the maximum speed is determined by the rate at which their body can expend energy. The comfortable range is determined by the total amount of energy that can be expended. The maximum load that can be carried is set by the power which they can generate. In practice, speed and range tend to be considered together by users in terms of

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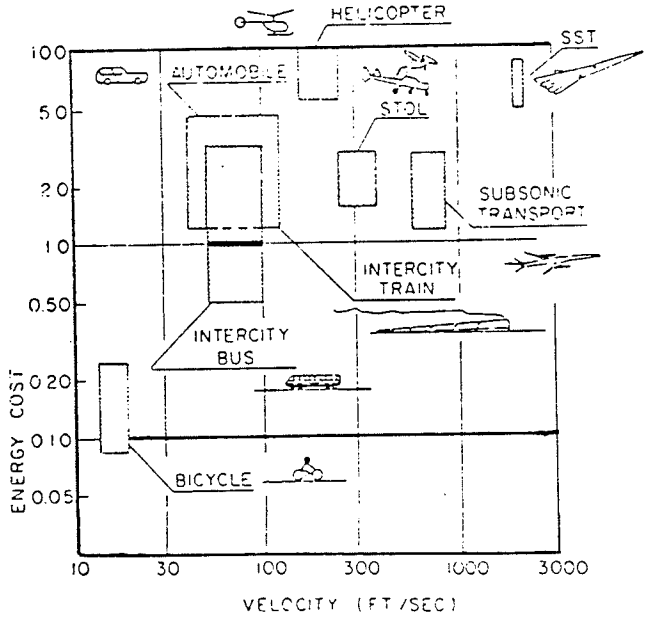
[1] Mike Hudson, *Bicycle Planning Book*, p.4.

time spent travelling. For modes other than public transport, the amount of time spent travelling for a given purpose shows a greater similarity between modes than the distance travelled. This is one of the main reasons why the majority of bicycle journeys are currently under 5 miles in length. It is possible that more of the future users will be prepared to spend more of their increasing leisure time travelling and that with an increase in health consciousness, people will want to keep better physically fit. The average length of journey considered feasible by bicycle will therefore probably increase.

The bicycle is one of the most efficient methods of using energy to transport the body. The cyclist saves energy by sitting, thus relieving his leg muscles of their supporting function and subsequent energy consumption. There is less waste of power for each mile covered, than any other type of man-made machine. Figure 7 illustrates how the bicycle consumes the least amount of energy per person transported.

FIGURE 7 ENERGY COSTS per PASSENGER TRANSPORTED



Source: Bruce McCallum, *Environmentally Appropriate Technology*, p.145.

The health and fitness benefits of bicycling are well documented. It benefits an individual's cardiovascular system and uses large muscle groups continuously. Second only to cross-country skiing, cycling is the next most efficient cardiovascular fitness exercise. An untrained novice cyclist may consume 3 litres of oxygen per minute of

activity, whereas a top cyclist may require as much as 5 litres of O_2/minute. Depending on the wind, traffic and terrain, cycling can provide a vigorous, aerobic workout that exercises the legs but also the upper body to a lesser degree. Athletes that use cycling to stay in shape, reported that the duration of injuries among cyclists was less than for athletes in other sports; 11 days for cycling, compared to, 13 for swimming, 26 for triathletes and 40 for joggers (Koch 1988:32).

Cycling provides the opportunity to experience your city on a different scale, while simultaneously improving one's fitness. The bicycle has proven to be immensely popular among those looking for exercise. It has become the number one favourite outdoor activity in Canada. The Canadian Cycling Association estimates that there are 8 million Canadian cyclists. The response in the United States has been similar, from 1983 to 1987, the number of cyclists jumped 18% to 85 million and the number of Americans who rode a bike at least once a week, rose 59% to 17 million. In 1987, 12.6 million bicycles were sold, an increase of 40%.

Bicycling is a high calorie-per-minute activity that promotes changes in body composition and weight control. An exercise program can be tailored to the individual's ability, but it is important to attain a high degree of skill to safely enjoy cycling amongst the city traffic. Cycling for fifteen minutes or longer, at a speed fast enough to bring your heart rate into your target zone, is an excellent exercise for developing a high level of cardiorespiratory endurance. Also, cycling promotes muscular endurance and muscular strength, and improves the flexibility of selected muscles in the legs and hips. Table 3 provides some general figures for calories burned during cycling.

Table 3 Calorie Consumption

Speed (MPH)	Calories/Minute	Calories/Mile
22.5	24.0	64.0
21.0	19.5	55.7
18.5	15.0	48.6
16.0	10.5	39.3
12.0	6.0	30.0
8.3	3.8	27.0
6.0	2.7	26.5

Source: David L.Smith M.D., *Bicycling*, p.96.

Health

Health-related costs have, of recent, began to dominate Provincial and Federal expenditures. This expenditure has steadily consumed an increasing proportion of the Canadian Gross National Product - 5.6% in 1960, 7.5% in 1971 and 8.4% in 1982 (Statistics Canada 1985:94). Health-related costs are inextricably embedded in companies of all sizes. For example, in the last five years, the General Motors Corporation has spent three times as much on health insurance as for steel to manufacture automobiles (Sharratt and Cox 1988:S40). The overall cost of health care in Canada, including expenditures by the private sector and all levels of government, was $30.1 billion in 1982, up 16.8% from 1981. This reflects the 2 years previous, when annual increases of 16% each, were recorded. On a per person basis in 1982, this figure represents $1 220, up $168 dollars over 1981 (Statistics Canada 1985:94). Employers pay an enormous price in terms of absenteeism, turnover, retraining and decreased productivity. Some companies acknowledge that a strategy aimed at wellness and lifestyle modification may assist in containing health care costs and improve their competitiveness. Regrettably, the cost/benefit analyses tend to be crude and inconclusive. Few enlightened companies do provide sports and recreation programs to promote health and physical fitness. This initiative has been implemented often in spite of difficulties in justifying the financial outlay, especially when there is usually low numbers of participants, and they tend to be healthy and active in the first place. However, it is thought that a highly visible employee fitness program could have a "ripple effect" throughout the "reluctant majority" of employees. Thus, the challenge is to devise innovative recreation strategies, combined with personal commitment and action on behalf of the employee.

The Canada Health survey released in the early 1980s, reported that 800 000 Canadians had heart problems in 1979: over one-half of these were persons of working age. They estimated that heart problems caused over 300 000 persons to be restricted in daily activities and over 100 000 to have disability days. In Canada, the overall leading cause of death is cardiovascular diseases, almost doubling the next closest cause. It is most prevalent in persons over the age of 44, with a declining significance under this age. Table 4 illustrates the potential years of life lost prematurely. Heart disease is shown to be the number one cause of potential years of life lost among males. Motor vehicle accidents in 1978 resulted in 15.2% of the total number of PYLL, but this represents only 6.5% of those who died. In contrast, heart disease reported a similar percentage of PYLL, but 25.4% of the total number of deaths.

Table 4 Potential Years of Life Lost (PYLL)
by selected Causes and Sex, 1978

	PYLL between ages 1 and 70				Deaths between ages 1 and 70	
Cause of Death	Males	Females	Total	%	Total	%
Motor Vehicle Accidents	142 049	48 650	190 699	15.2	4 762	6.5
Ischemic Heart Disease	149 740	38 388	188 128	15.0	**18 607**	**25.4**
Accidents (other than car)	112 587	31 695	144 282	11.5	4 222	5.8
Suicide	80 693	22 995	103 688	8.3	3 237	4.4
Other	367 739	259 849	627 588	50.0	42 497	58.0
TOTAL	852 577	401 577	1 254 385	100.0	73 497	100.0

Source: Statistics Canada, *Canada Year Book 1985*, p.99.

Of the four leading causes, there is only one that external forces can realistically have any significant impact on, in an attempt to lower it. That is heart disease. A proper diet and a regular exercise program will result in ameliorating this number, especially among males. A study just completed at the University of Houston analyzed the connection between exercise and heart attacks. The study required 8 years to complete and had 3 100 males participate. They discovered that regular exercise will assist in the prevention of heart attacks, but more importantly, it places the heart in a better position to tolerate the effects of a heart attack, ie. it helps ensure that the severity is reduced and also speeds the recovery. The study concluded by reporting that of those least fit, they were 8.5 times more likely to die from cardiovascular disease and 6.5 times more likely to die from coronary problems, than those who were most fit.[1]

There has been a growing recognition among business and industry, that a strategy of exercise/activity programs may provide a means of improving the health of employees and thus reduce the rising costs of absenteeism, disability, and health insurance. The spin-off of a successful program will assist governments in lowering their expenditures on health care, and as such, furnish the justification for greater involvement in providing additional recreation facilities. However, there is less willingness to make a financial commitment without greater solid evidence proving that such an undertaking would be cost-effective.

[1] As reported by Mary Jane Conwell, C.K.Y. News, 30 November 1988.

Studies conducted in the field of business provide useful insights into more recent explorations of cost/benefit analyses of exercise programs. Although evidence exists to suggest that fitness programs in industry improve morale, self-esteem and a feeling of well-being, there has been a paucity of controlled scientific studies to provide objective data on the "bottom-line" dollar benefits that result from such programs. At best, the current projections of fiscal benefits are crude estimates. Over the past few years evidence has accumulated which illustrate that a more specialized and personal employee fitness program can play an important role in reducing absenteeism, health insurance costs and turnover, while simultaneously increasing productivity and job satisfaction. A cross-sectional study from Sweden in 1986 on 1 313 employees concluded that "the single risk factor that showed the strongest connection with absenteeism was a low degree of physical activity during leisure hours" (Sharratt and Cox 1988:S41).

In Canada, the rapid development of employee fitness programming, can be chiefly attributed to the immense interest of the Federal government in improving the health and fitness of Canadians. Various programs emanating from the Department of Health and Welfare include:

- An experimental employee fitness program in Ottawa post offices in the early 1970s.
- The establishment of Participaction (1971), an independent organization, subsidized by financial grants from the government.
- Various conferences on fitness and health and publishing literature.
- The 1973 Nutrition Canada Survey indicating that sport and exercise facilities should be available at places of work. (Sharratt and Cox 1988:S41)

The 1986 Canadian Summit of Fitness resolved that "a comprehensive program be developed and implemented to promote fitness and healthy lifestyles in the workplace with special emphasis on small- and medium-sized establishments" (Sharratt and Cox 1988:S41). Present governments in Canada acknowledge the important role that promoting healthy lifestyles have in possibly saving the expenditure of millions of dollars in medical costs in the future.

> ...the promotion of sports is a general way to improve the style of life of all Canadians. Spending money on facilities and promoting healthy lifestyles does reap dividends - maybe not in the immediate future but certainly long term dividends. Healthy lifestyles through recreation and better nutrition are a key to cutting future health care costs. (Winnipeg Free Press, 4 November 1988:60)[1]

[1] Provincial sports ministers conference held in Winnipeg in November 1988.

As of 1984, there were over 800 organizations in Ontario that operated employee fitness programs encompassing 40 000 employees, as well, over 2 300 companies had some type of sports and recreation program.

The costs of implementing an exercise program are easily documented but the benefits are often difficult to isolate and quantify. Two studies which were large-scale systematic examinations of fitness programs formulated a cost-benefit conclusion that provides some useful insight. The first was the Prudential Insurance study which was initiated in 1978 and over a five year period demonstrated a 20% reduction in disability days for employees adhering to the fitness program. Major medical costs showed a 46% reduction (Sharratt and Cox 1988:S42). The second was a federally subsidized project in 1978 that attempted to document costs and benefits associated with the introduction of employee fitness and lifestyle programs. The economic gains of decreased absenteeism among program participants were calculated to be as high as $175 000 when both direct and indirect costs were included. Program participants were shown to use the medical care system less frequently, at a cost savings to the system of approximately $130 dollars per person.

As noted previously in Table 4 PYLL, the primary risk of premature death in middle-aged men relates to coronary heart disease. In many cases, an unhealthy lifestyle has contributed to the disease. The apparent relationship between increased physical activity and the reduced risk of acute heart attacks forms part of the justification for enhancing the available recreation facilities. A debilitating disease or the loss of a life has an immeasurable impact on the individual's family, but the loss also extends to the person's employer. The cost to companies in terms of "lost" working hours due to premature death, retraining, sickness and bereavement is enormous. The American Heart Association estimates a cost of $700 million dollars per year to replace the 200 000 men aged 45-65 years who die or are disabled from coronary heart disease (Sharratt and Cox 1988:S42). Also, the Xerox Corporation estimates a cost of $600 000 dollars per year for each executive who dies and must be replaced (Sharratt and Cox 1988:S42). This prompted Fitness Canada to conclude in a 1987 publication that "if a fitness program prevents just one heart attack of a key staff member, that alone will pay for the cost of the program for the whole year".

The proliferation of employee fitness and lifestyle programs over the past few years is an indication that business/industry is responding to increased public awareness of the

potential benefits related to work-site programs. Government departments have a dual role to play in reducing health care costs. First, as the largest employer in the country, an exercise/fitness and lifestyle program will reach an enormous number of Canadians, and secondly, various departments can provide the facilities necessary for recreation strategies. The provision of bicycle facilities is an important step towards encouraging more people to exercise. Cycling is currently the number one outdoor activity among Canadians, and appeals to individuals of all ages who may enjoy it at their own pace, including those with mobility impairments. The many benefits which accrue from additional cyclists include: an improvement in the health of the participants, thereby lowering health-related expenditures by both the public and private sector; and secondly, a move away from the automobile towards the bicycle will reduce the need and costs associated with the planning, construction and maintenance of the roadways, a reduction of vehicle congestion and a decrease in the level of pollution.

2.34 Topography

Steep gradients can deter cyclists, especially if they are not particularly strong or fit. But given a bicycle with adequate gearing, which most modern bicycles have, climbs of moderate steepness are not debilitating. Hilly topography does not, therefore, automatically restrict bicycle use. Descents do not have the reverse effect of climbs. In urban areas cyclists travelling downhill are limited by traffic. In Winnipeg, as with the surrounding hinterland, the topography is not a concern as it is flat.

2.35 Traffic

Traffic is thought to be not a strong a deterrent to cycling. But on the contrary, heavy traffic has the effect of increasing the range over which cycling is competitive with vehicle commuting. Traffic, however, both delays and fatigues cyclists, thus reducing their average speed and decreasing their range proportionally.

Parallel traffic and cross traffic affect cyclists differently from motorists. Parallel traffic affects cyclists less than motorists. Even in congested areas there is usually sufficient roadway width available for cyclists to share the lane with stopped motorists, thus enabling cyclists to filter through traffic jams. In heavy traffic cyclists must therefore travel faster than motorists.

Conversely, cross traffic will affect cyclists more than motorists. Cyclists attempting to cross heavy arterial traffic at unsignalized intersections must wait for longer gaps than motorists require, and as a less conspicuous entity, they have less ability to halt traffic than motorists can, when they decide to enter the intersection. The effects of cross traffic on cycling is variable and the possibilities are numerous. Fortunately though most urban traffic is either slow enough to allow a cyclist to filter through or is bunched into groups by upstream signals, to allow the cyclist to pass through. The worst situation arises when groups of traffic from opposite directions overlap each other's gaps at the cyclist's desired crossing location.

Traffic signals provide a small and predictable delay in the flow of automobiles, and as such, are useful in congested areas. Since cyclists are less adversely affected by parallel traffic but more so by cross traffic than motorists, traffic signals along the cyclists route are more advantageous to the cyclist than to the motorist. However, restarting a bicycle consumes an immense amount of energy. Cars consume much more fuel in stop-and-go traffic, but they are not limited by the fuel-consuming and power-producing capabilities of their vehicles. Whereas a cyclist is limited. Accelerating to the same peak speed from a stop is exhausting. In addition to the time lost during the delay, is the time required to accelerate to normal travelling speed after stops. Numerous stops inhibits the cyclists ability to achieve the higher travelling speed. For this reason, a properly functioning traffic light network is far more advantageous to the cyclist than improperly operating ones or a system of stop signs. The cyclist can pace himself alongside the vehicle traffic so that he obtains green lights with the minimum of speed change. Since main arterial streets generally have a higher proportion of green time and are more likely to operate predictably in the direction of arterial travel, signalized arterial streets are by far the cyclists best choice for urban trips in dense traffic areas, provided the outside lane is wide enough.

On arterial streets with less traffic, they are protected by stop signs at minor intersections and traffic lights at major intersections. Since stop signs protecting the arterial street physically guarantee a no-stop situation, such arterial streets are a cyclists best route in suburban areas.

On the other hand, stop signs across the line of travel impose a 100% probability of stopping. Because of the additional fatigue caused by constant acceleration after stops, cyclists avoid routes with many stop signs. Davis, California discovered that cyclists and motorists departing from the same location and travelling to the identical destination, will

select very different routes. The cyclists chose routes that had very few stop lights but more stop signs, whereas motorists opted for routes that had very few stop signs and more stop lights.[1] Cities that have installed a network of stop signs to impede motor traffic have adversely affected cyclists far more than motorists, and have served to channel many cyclists onto the major arterial streets which utilize traffic lights. Due to the effort required, many cyclists choose not to obey the stop signs and drive through without slowing or looking. Presumably it is these cyclists that are incurring more collisions with cars.

The unsignalized intersection between residential streets requires that fast cyclist slow down, but has little effect on slow cyclists. Since commuting cyclists tend to travel faster than either local utility cyclists or recreational cyclists, commuting cyclists tend to avoid residential streets.

As the cyclist travels along the street, he is forced to continually breathe in the pollution created by nearby automobiles. The cyclist who travels faster and is working harder, has to breathe more frequently and as such inhales greater proportions of pollutants. Table 5 illustrates the level of air pollution as a function of traffic flows and distance from the road. Table 6 shows the traffic levels on four of Winnipeg's major arterial routes. In the USA federal standards set the inhalation of carbon monoxide levels at 35 parts per million (ppm) for a period of one hour, as the maximum level, levels greater than this are unacceptable.

Table 5 Air Pollution Levels as a Function of Traffic and Distance from the Road

	POLLUTION LEVELS (CO parts per million)	
Traffic Count (cars/hour)	Curb-side levels at urban intersections	Levels 9 to 15 m from traffic streams
over 4 800	56	11
3 600 - 2 400	32	7
Less than 2 400	15	3

Source: Mike Hudson, *Bicycle Planning Policy and Practice*, p.13.

[1] The author reasoned that cyclists chose routes with the stops signs because they would ignore the sign and stop only when it was warranted due to traffic loads. And motorists usually stop at the signs because of the severe punishments meted out for failure to obey. With stop lights the motorist has a fifty-fifty chance of travelling through without being required to stop.

Table 6 Traffic Capacity on Major Thoroughfares in Winnipeg

Street	7 AM - 7 PM Average Weekday	AM PEAK Hour Loads	PM PEAK Hour Loads
PORTAGE	52 291	5 257	5 314
PEMBINA	33 519	3 722	4 002
MAIN	26 200	2 345	3 259
HENDERSON	28 400	3 465	4 087

For all two-way traffic entering and leaving the downtown.
Source: Streets and Transportation Department. *1986 City of Winnipeg Traffic Flow Map.*

Since bicycles operate very silently, noise becomes an unpleasant and irritating deterrent to cyclists; in particular, routes used by large numbers of heavy goods trucks and buses are avoided.

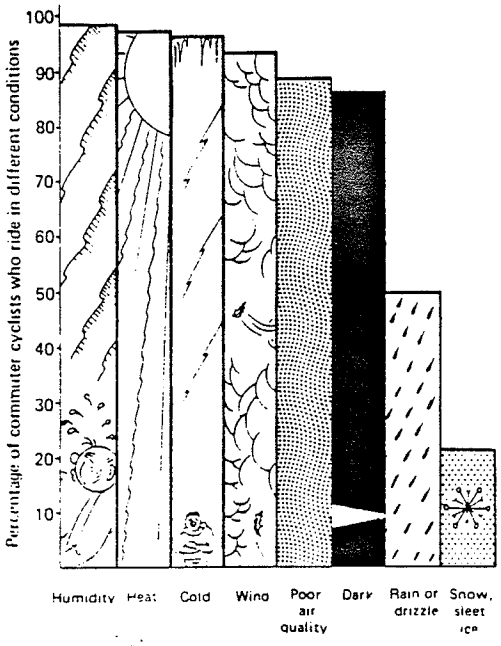
2.36 Carrying Capacity

Touring cyclists may carry as much as 30 pounds of equipment, but this requires specialized racks and bags and will severely limit performance. Cyclists on local utility trips, such as from the local grocery store, may carry 20 pounds with relative ease using a typical rack, saddlebags and backpack. They may also, if they intend to move a large load, hitch up a trailer capable of transporting approximately 100 pounds. Cyclists on commuting trips of any significant distance will tend to avoid loads exceeding 10 pounds. The carrying capacity is limited by both the need for good performance and the cyclists' ability.

2.37 Weather

The natural constraints of climate play an important role in determining the pattern of bicycle use. Cycling is particularly sensitive to its influence, but there is no rule for the effect of climate upon cyclists, it depends entirely on the individual. Figure 8 provides an example of the effect of weather on commuting cyclists as reported in a study on bicycling in Washington, D.C.

FIGURE 8 EFFECT of WEATHER on COMMUTING CYCLISTS



Source: Mike Hudson, *Bicycle Planning Policy and Practice*, p.4.

There exists a marked propensity for decreases in the volume of cycling during less suitable weather, with greater decreases during unusually poor weather for the locality. However, dependent on the normal conditions for the locality, the cyclists will eventually adjust to the weather for continual cycling. With greater use of the mountain bike, the duration of the cycling season is becoming extended into the winter months.

On average, Winnipeg experiences approximately 57 days of measurable snow fall and 72 days of measurable rain fall annual. It also averages 131 days of snow cover on the ground, from the first remaining snowfall to the last, usually 30 November to 30 March. The following figures were for 1987 and were measured at the Winnipeg International Airport.

Table 7 Meteorological Data for the Year 1987

Number of Days With:	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Measurable Rain	0	0	2	3	8	12	15	11	9	6	5	3	74
Rain (trace or more)	3	3	8	9	15	16	19	17	15	10	9	6	130
Measurable Snow	8	11	9	0	0	0	0	0	0	5	1	8	42
Snow (trace or more)	16	17	14	1	0	0	0	0	0	10	7	21	86
Measurable Precipitation	8	11	9	3	8	12	15	11	9	10	6	9	111
Precip. (trace or more)	16	18	17	10	15	16	19	17	15	18	14	22	197
Thunderstorms	0	0	0	1	3	5	5	5	3	0	0	0	22
Hail	0	0	0	0	0	0	0	0	0	0	0	0	0
Ice Pellets	0	0	2	0	0	0	0	0	0	0	0	2	4
Freezing Precip.	3	3	3	0	0	0	0	0	0	1	4	3	17
Fog*	1	1	2	0	0	1	4	0	2	2	2	4	19

* Fog is only recorded when visibility is restricted to 1/2 mile or less.
Source: Environment Canada, *1987 Annual Meteorological Summary Winnipeg*, p.9.

Table 8 Monthly Precipitation Levels in Winnipeg 1987

	MONTHLY			NORMAL		
Month	Rainfall	Snowfall	Total	Rain	Snow	Total
JAN	tr.	11.0	10.4	0.2	23.7	21.3
FEB	tr.	42.2	40.8	0.7	18.9	17.5
MAR	1.4	12.6	13.3	3.3	21.1	22.7
APR	0.8	tr.	0.8	27.1	11.3	38.5
MAY	31.6	0.0	31.6	63.2	2.5	65.7
JUN	55.2	0.0	55.2	80.1	tr.	80.1
JUL	130.1	0.0	130.1	75.9	0.0	75.9
AUG	97.1	0.0	97.1	75.2	0.0	75.2
SEP	20.0	0.0	20.0	53.0	0.2	53.3
OCT	23.2	10.4	33.4	25.9	5.2	30.9
NOV	11.0	1.0	11.2	5.5	21.9	25.2
DEC	5.8	10.2	14.6	0.9	20.7	19.2
TOTAL	376.2	87.4	458.5	411.0	125.5	525.5

Total Precipitation in millimetres.
Source: Environment Canada, *1987 Annual Meteorological Summary Winnipeg*, p.1.

Table 9 Monthly Average Temperature in Winnipeg 1987

	Temperature (C)						
MONTH	NORMAL			EXTREME			
	Max	Min	Mean	Max	Date	Min	Date
JAN	-14.3	-24.2	-19.3	5.7	12	-35.4	23
FEB	-10.1	-21.0	-15.6	3.3	6	-20.5	8
MAR	-2.8	-13.5	-8.2	9.9	21	-26.0	9
APR	8.9	-2.2	3.4	30.5	18	-12.6	2
MAY	18.0	4.5	11.3	34.1	15	-3.5	22
JUN	23.1	10.5	16.8	35.0	15	-3.5	22
JUL	25.9	13.3	19.6	33.3	28	9.0	3
AUG	24.7	11.8	18.3	31.3	2	2.8	31
SEP	18.4	6.3	12.4	29.3	14	-1.4	30
OCT	11.5	0.7	6.1	23.1	3	-10.5	24
NOV	-0.3	-8.8	-4.5	14.8	11	-14.7	20
DEC	-9.4	18.6	-14.0	3.6	8	-25.8	31
YEAR	7.8	-3.4	2.2	35.0	Jun15	-35.4	Jan23

Source: Environment Canada, *1987 Annual Meteorological Summary Winnipeg*, p.2 & 3.

It is apparent that Winnipeg winters are extremely harsh, however, cycling surveys and accidents statistics indicate that cycling is enjoyed year round by many enthusiasts. This practice does require a great deal of experience, as allowances must be made for road condition, sight visibility and braking abilities.

The following two tables of meteorological data are comprised of two important factors when cycling, sunshine and wind. Accident statistics show that many accidents occur at dawn/dusk or at night due to the difficulties in trying to discern an unlit or improperly marked bicycle. Conversely, wind has a significant debilitating effect on cycling. Cycling head-on into the wind requires an enormous amount of energy and stamina to travel any significant distance.

Table 10 Sunshine in Winnipeg 1987

SUNSHINE				
MONTH	Duration in Hours	% of possible	No. of Days w/o sunshine	Normal in Hours
JAN	99.2	37.1	6	121.2
FEB	58.5	20.8	14	144.2
MAR	155.7	42.3	5	176.2
APR	282.3	68.4	0	219.8
MAY	276.6	58.0	0	265.6
JUN	366.5	75.0	0	276.1
JUL	266.8	54.2	1	315.6
AUG	263.0	58.7	0	283.3
SEP	192.7	50.8	2	184.6
OCT	158.9	47.6	5	151.5
NOV	121.6	44.6	8	90.7
DEC	62.9	24.8	14	92.6
YEAR	2304.7	51.5	55	2321.4

Source: Environment Canada, *1987 Annual Meteorological Summary Winnipeg*, p.2.

Table 11 Wind in Winnipeg 1987

WIND (KM/H)						
			Normal		Highest Gust	
MONTH	Avg. Speed	Prevailing Direction	Speed	Direction	Direction	Date & Speed
JAN	15.2	S	18.6	S	SSE 85	4
FEB	15.7	S	18.1	S	NNW 72	7
MAR	15.8	S	19.3	S	S 54	3
APR	17.4	S	20.9	S	SSE 67	19
MAY	17.6	S	20.2	S	S 70	12
JUN	15.4	W	18.1	S	W 63	1
JUL	13.1	S	16.0	S	S 54	5
AUG	13.7	W	16.4	S	S 61	5
SEP	12.8	S	18.5	S	S 59	3
OCT	17.1	S	19.6	S	N 96	1
NOV	15.3	S	19.4	S	NW 63	4
DEC	14.2	S	18.6	S	N 63	30
TOTAL	15.3	S	18.6	S	N 96	Oct 1

Source: Environment Canada, *1987 Annual Meteorological Summary Winnipeg*, p.2.

2.38 Bicycle versus Automobile

The bicycle offers the user a vehicle which is quick and versatile, attributes which are well-suited to a congested urban environment. It is convenient as it provides door-to-door travel, and improves the health of the cyclist as it is an excellent aerobic exercise. One of the most appealing characteristics of the bicycle is its inexpensiveness. After the initial purchase price, the operating costs remain negligible and the user possesses the ability to park virtually anywhere for free of charge. This compares quite favourably with the automobile. In addition, there exists many benefits which accrue to the city. It is in the public interest to encourage residents to cycle since increased use can result in reduced pollution; reduced use of non-renewable energy resources; reduced congestion; improved public health; reduced transportation costs; increased mobility for many city residents; and an enhanced quality of life for Winnipeg citizens. A significant reduction in the number of automobiles used will decrease the need for the continual expansion and widening of the road network and subsequently reduce the total expenditure required to plan, construct and maintain this transportation system. Table 12 summarizes the total expenditures in Manitoba for the years 1981-83 by both public and private sources for highways, roads, streets and bridges.

Table 12 Manitoba Expenditures on Highway, Road, Street and Bridge Construction
(in Millions)

	FEDERAL & PROVINCIAL GOVERNMENT		MUNICIPAL GOVERNMENT		ALL OTHER SECTORS		TOTAL
	New	Repair	New	Repair	New	Repair	
1981	102.4	31.7	35.1	5.7	14.7	3.4	**193.0**
1982	105.9	46.8	28.6	5.9	8.6	3.4	**199.2**
1983	105.9	48.8	42.1	6.2	7.4	3.6	**214.0**

Source: Statistics Canada, *Canada Year Book 1985*, p.424.

With many desirable areas in which to cycle, it is in the economic interest of the city to encourage people to visit Winnipeg for bicycle touring, bicycle races and other leisure activities. A bicycle path is capable of producing some very positive side-effects. A recently completed 1986 study of Wisconsin's Sugar River Trail determined that the bicycle path users on the trail had spent between $400 000 and $600 000 US each year, at the various shops and stands lining the route. A 1987 study on the effects of the 20-kilometre Burke-Gilman Trail in Seattle, Washington concluded that property values near the trail had

risen, and burglaries and vandalism of adjacent homes were well below the neighbourhood average.[1]

The bicycle is no longer confined to the elderly, youth or those without access to an automobile. The number of adults who routinely *use* a bicycle has jumped dramatically and most of these converts are women. A Statistics Canada survey in 1987 studied 18 Canadian cities and found Winnipeg ranked 12th overall in terms of *ownership* of adult-sized bicycles. This represents a drop of 4 places since the survey was originally conducted in 1982.[2] Although this is a decrease on a nation-wide comparison, there has been an increase in the level of ownership in Winnipeg over the last five years. A breakdown of the 1987 statistics for Winnipeg indicate that there are over 119 500 households that possess adult-sized bicycles of which 64 300 own two or more. See Table 13.

Table 13 Vehicle Ownership in Winnipeg as Percent of Households

	One	Two +	Three +	Without
BICYCLES	23.0%	26.8%		50.2%
AUTOMOBILES	48.0	22.6	5.7	23.7
VANS & TRUCKS		17.3		81.3
MOTORCYCLES		4.2		95.4

Source: Statistics Canada, *Household Facilities and Equipment Survey 1987 Special Tables*. 1988.

Over the past five years there has been a very slight increase in the number of households which own an automobile. Concomitantly there has been a marked trend for bicycle sales to frequently exceed those of car sales in the city. There were over 100 000 bicycles sold in Manitoba last year while only 30 000 cars and trucks were bought in Winnipeg.

There are many financial disadvantages to owning an automobile. During the last six years the average automobile purchase price has risen by 50%. Domestic car prices average $15 600 while imported cars are slightly more expensive.[3] Coupled with this, is the increasing cost of operating a vehicle. The Canadian Automobile Association estimates that the average cost of running a car has climbed to 31.4 ¢/km in 1988, up from 29.7¢/km

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[1] Mercer Cross. "From rails to bicycle trails". Winnipeg Free Press. 7 May 1988. p.4A.

[2] Statistics Canada Household Surveys Division, *Household Facilities and Equipment Survey*, 1987 and 1982.

[3] Winnipeg Free Press, 2 October 1988, p.13.

last year.[1] This figure is comprised of automobile insurance, licence and registration, depreciation, finance charges, gasoline and oil costs, maintenance and tires. The CAA also reports that the average car repair costs, based on the largest nine automobile manufacturers, has increased by 33% in 1987 over figures recorded in 1986.[2] The aggravation of car ownership is exacerbated by the difficulties one has in attempting to park in the downtown due to the paucity of available parking stalls and the costs of paying to occupy one. In 1986 there were 35 512 parking stalls in the city centre. This represents a modest increase of 2% from 1980. Of these 32 042 were off-street and 3 470 on-street.[3] The automobile user is also faced with paying for the always increasing price of fuel. Across Canada the average selling price of gasoline in October was 48.2¢/litre.[4] Winnipeg car owners consume approximately twelve million litres of gasoline *per week*.[5] On an annual basis this extrapolates to 698 Million litres of gasoline and 45 Million litres of diesel fuel.[6] On a Provincial basis, the consumption of gasoline recorded in 1982 was 1 260 Million litres. This represents a gradual decrease in consumption of 10% since 1980.[7]

Irrespective of the impediments associated with car ownership, Winnipeggers are taking to the car for the purpose of commuting to work, at a much more rapid rate than bus/car passenger mode, walking or bicycling. Table 14 illustrates the large increase in the number of work trips and that this increase has almost been accommodated solely with the automobile.

Table 14 Winnipeg Downtown Work Trips by Mode of Travel

	1976	1981	1986
Total Work Trips	99 200	103 265	114 924
Vehicle Driver	56 725 (57.2%)	59 459 (57.6%)	67 425 (58.7%)
Bus Passenger	21 723 (21.9%)	23 027 (22.3%)	25 085 (21.8%)
Vehicle Passenger	11 614 (11.7%)	11 501 (11.1%)	12 784 (11.1%)
Walk/Cycle	9 138 (9.2%)	9 278 (9.0%)	9 630 (8.4%)
	100.0%	100.0%	100.0%

Source: City of Winnipeg, *Travel and Demographic Trends 1962-1986*, p.16.

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1 These figures are based on the operational costs arising from the use of a test vehicle. The CAA conducted these tests using a Ford Tempo.

2 Winnipeg Free Press, 14 August 1988, p.13.

3 City of Winnipeg, *Travel and Demographic Trends 1962-1986*, p.7.

4 Winnipeg Free Press, 16 October 1988, p.13.

5 Costas Nicolaou, Winnipeg Free Press, 12 October 1988, p.7.

6 C.S. Davis et. al.. *Proposed Automobile Emission Standards on Air Quality Assessment.*

7 Statistics Canada, *Canada Year Book 1985*, p.425.

This also highlights the preference of Winnipeggers as they are decidedly moving away from bus transportation as it has experienced a loss of patrons in terms of the percentage of commuters it transports from 1981 to 1986. The Travel and Demographic Trends study also revealed that the commuter cars almost always are transporting only a driver with no passengers. Car pooling presently comprises a small component of commuter travel within the city. The number of persons per automobile was 1.19 in 1986 during the morning peak hour work trips.[1] This figure has remained constant since 1981.

In a congested urban system the bicycle is capable of transporting its operator to his/her destination quicker than an automobile and much faster than a transit bus. In almost all studies comparing the three modes for quickness, the bicycle came out on top. In Toronto one study revealed that the bicycle operator arrived at the destination one minute before the car driver and 2.5 minutes before the transit user.[2] The three commuters travelled 6.2 kilometres during the morning rush hour. Figure 9 illustrates the travel time contours for an automobile and Figure 10 depicts contours for transit buses, indicating the travel time to the downtown during morning rush hours. Both of which the bicycle is capable of meeting or bettering.

Transit's ability to compete is greatly inhibited by the over 4 300 bus stops in the city. The speed of which auto traffic is capable of travelling the street network is shown in Figure 11. Vehicles average over 40 km/h in the outlying areas, (Zone 3 Figure 11), where traffic is relatively sparse, but become slowed as they approach and enter the downtown. The average speed slows to 25 - 40 km/h in Zone 2 and drops further to average below 25 km/h in Zone 1. Similarly Figure 12 represents the average operating speed of transit. In the outlying areas, (Zone 2 Figure 12), the average speed is between 16 and 32 km/h, but slows considerably, to between 8 and 16 km/h, upon entering the downtown, Zone 1. The bicycle can better the travelling time of either mode because the operator is able to: go directly from his/her home to work; use cycle paths if available; avoid having to search for parking space as parking is generally available at the work entrance; avoid heavily congested routes: and avoid traffic jams.

A very high proportion of trips currently made by automobile could easily be made by bicycle. In the United States motor vehicle travel reached 1.9 trillion miles in 1987, an

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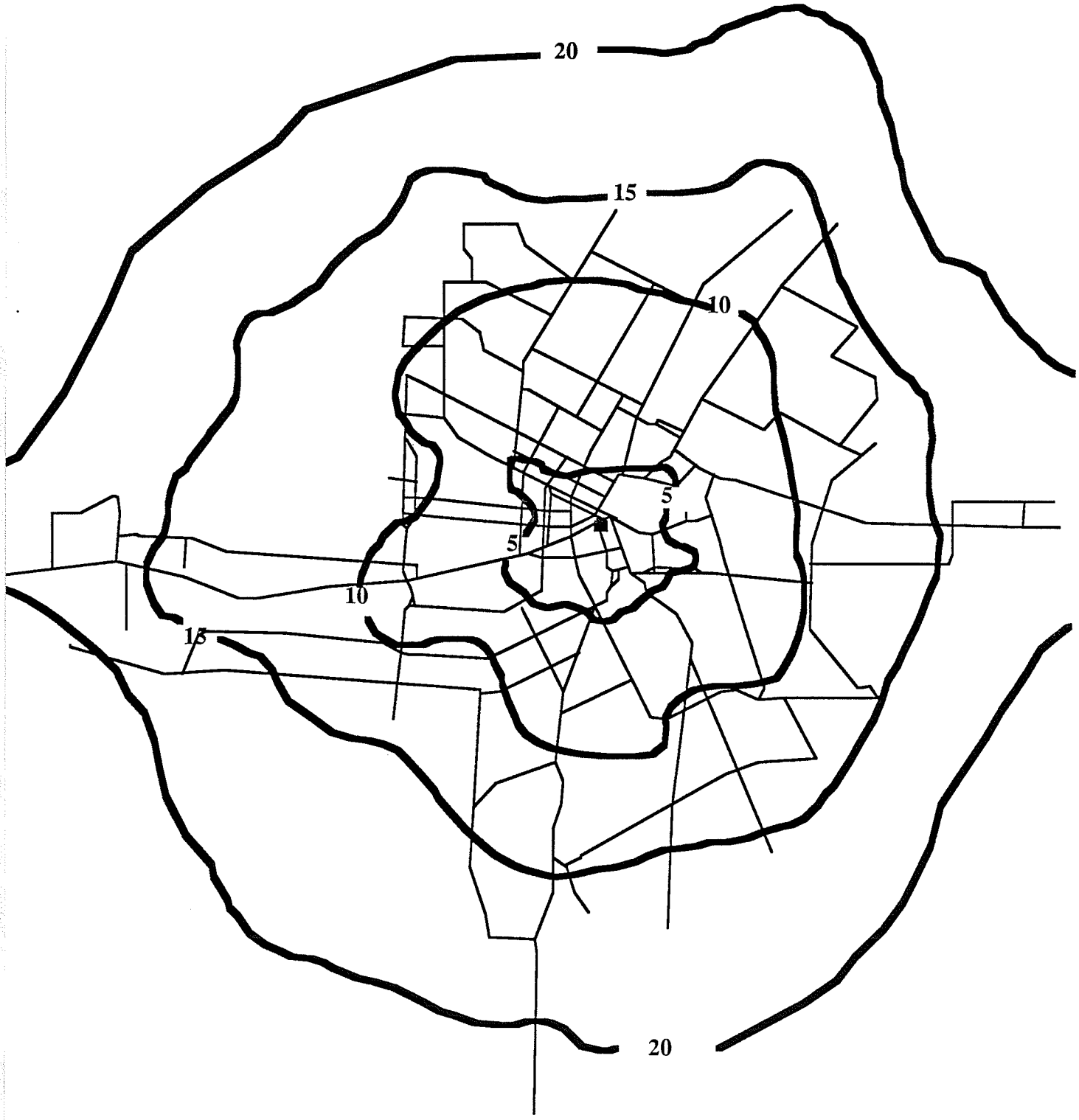
[1] City of Winnipeg, *Travel and Demographic Trends 1962-1986*, p.26.
[2] The Financial Post, 18 January 1988, p.16.

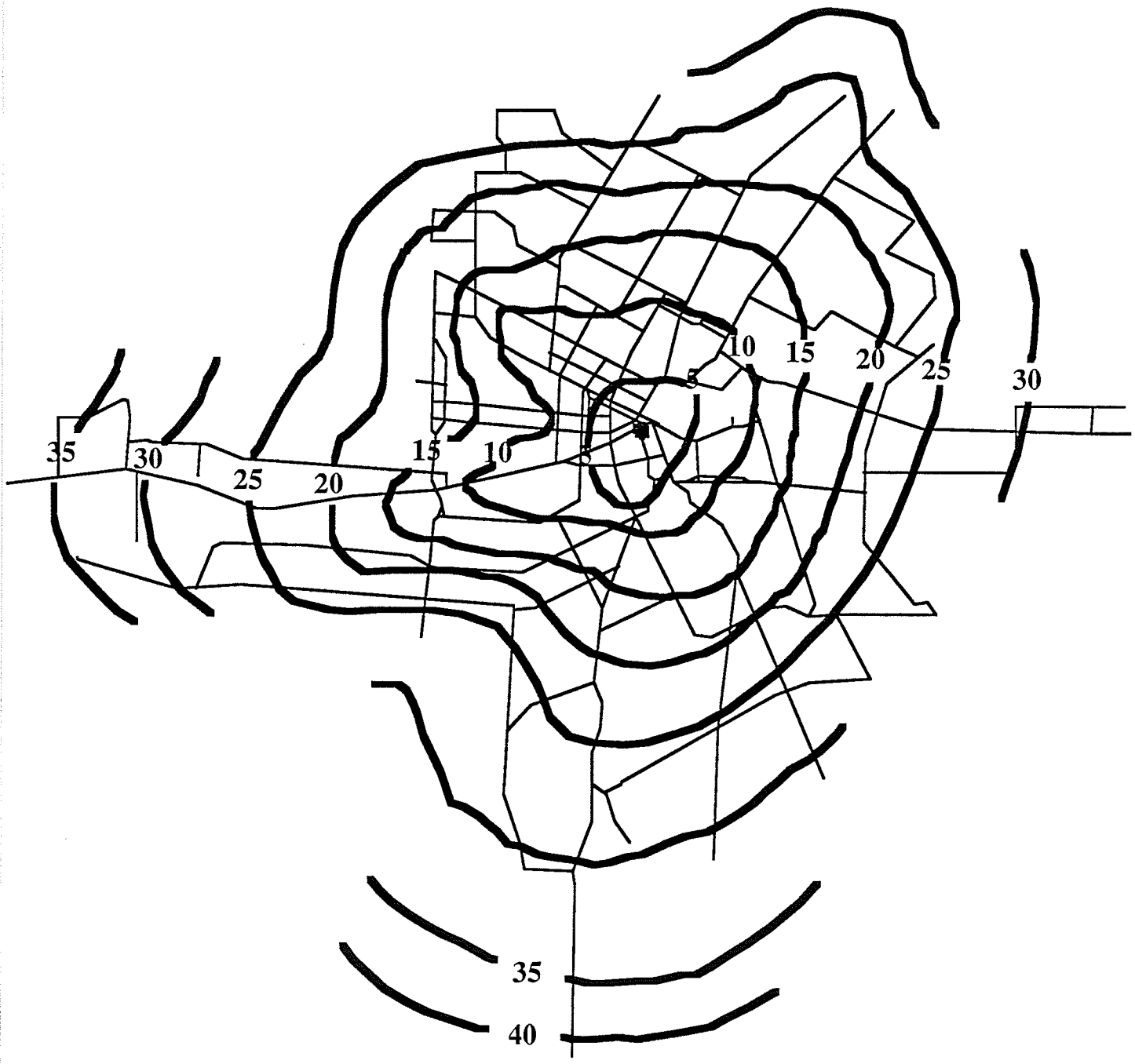
FIGURE 9 TRAVEL TIME CONTOURS FOR AUTOMOBILES



Note: Travel time, in minutes, by private automobile,
on the regional street system to the corner of
Portage Avenue and Donald Street.

Source: City of Winnipeg, *Travel and Demographic Trends 1962-86*, p.22.

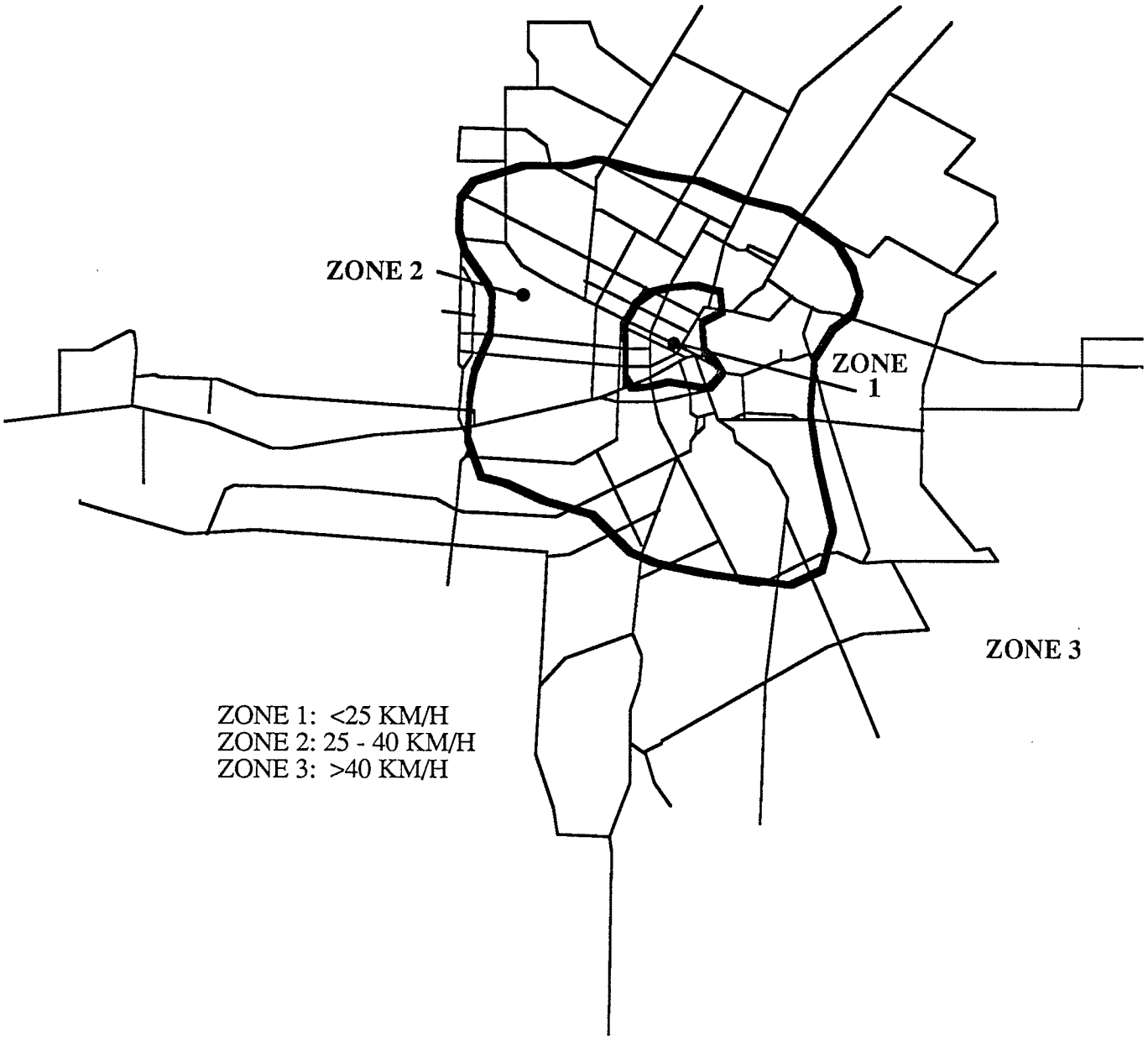
FIGURE 10 TRAVEL TIME CONTOURS FOR TRANSIT BUS



Note: Travel time, in minutes, aboard transit bus on the regional street system to the corner of Portage Avenue and Donald Street.

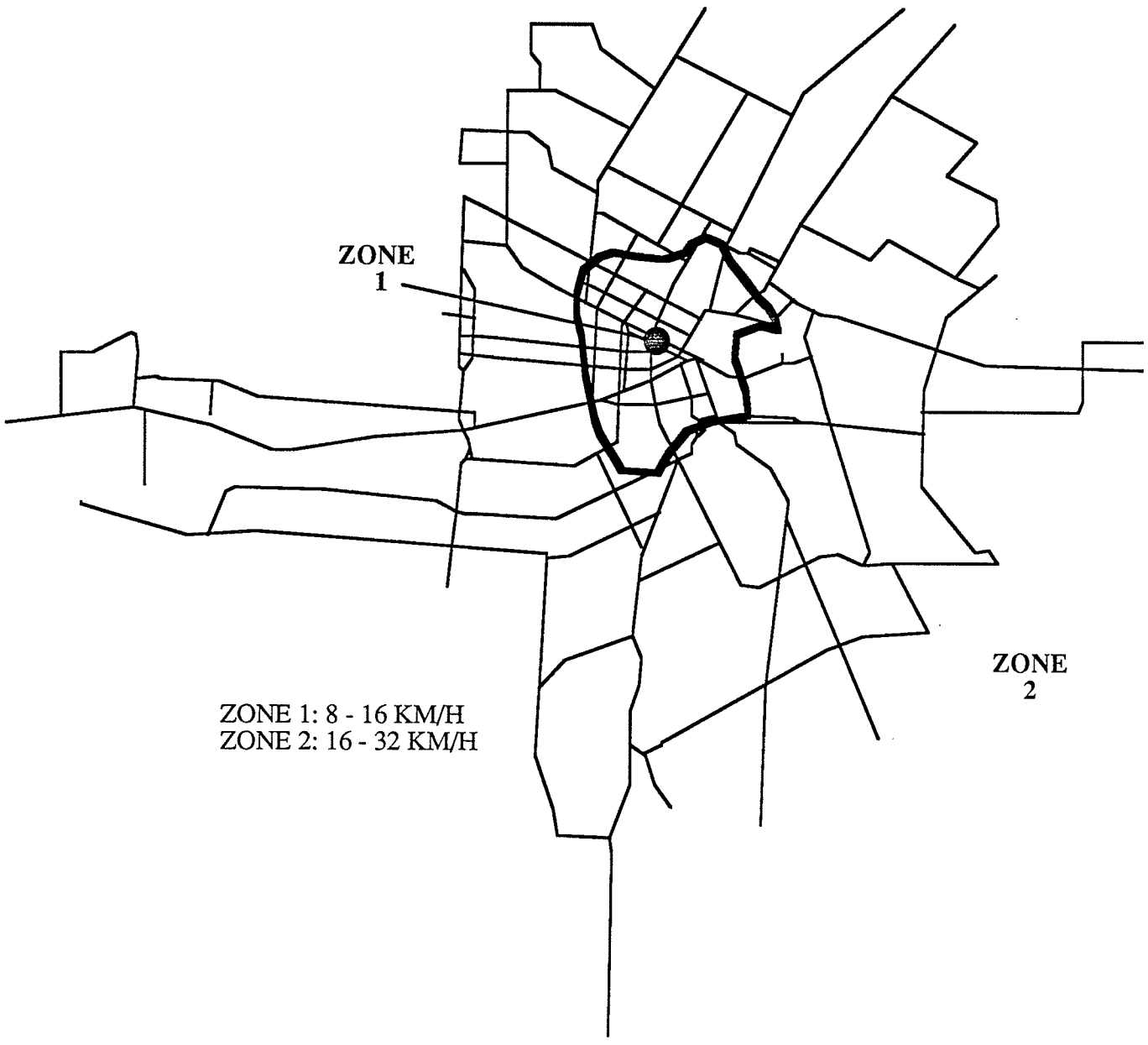
Source: City of Winnipeg, *Travel and Demographic Trends 1962-86,* p.23.

FIGURE 11 AVERAGE VEHICLE OPERATING SPEED



Source: City of Winnipeg,
Travel and Demographic Trends 1962-86,
p. 34 & 35.

FIGURE 12 AVERAGE TRANSIT VEHICLE OPERATING SPEED



Source: City of Winnipeg,
Travel and Demographic Trends 1962-86,
p. 53 & 54.

increase of 27% from 1977. This was accomplished through the operation of 181 million cars, trucks and buses, also up 27% from 1977.[1] Over 60% of the more than 100 billion trips made annually are five miles or less in length. These account for almost 17% of all vehicle miles travelled. Since the average commuting trip by bicycle is approximately four miles, most of these motorized trips from the standpoint of distance, could easily be made by bicycle. Even if the majority of this potential were discounted because of such inhibiting factors as vehicle load factors, age or physical condition of the tripmaker, inclement weather, darkness, difficult terrain, physical hazards or barriers to bicycle use, etc. this would still leave tens of billions of trips in the U.S. which could be converted to bicycle use. The U.S. Transportation Department calculated that vehicles on U.S. freeways now rack up 1.6 billion hours in delays for drivers stranded in traffic jams. They estimate that this number will rise to 8.1 billion hours by the year 2005 if no improvements are made.[2] A study by Priority Management Pittsburgh estimated that todays average motorist will waste six months out of their lifetime while waiting for red lights to change. A study by Psychologist Raymond Novaco at the University of California concluded that chronic exposure to traffic congestion tends to give drivers an increase in baseline blood pressure, a lowering of frustration tolerance, an increase in negative mood and aggressive driving habits. Thus he states that commuters who drive to work function less effectively than those who don't drive because they arrive more tired and very irritated. In addition the stop 'n go travel wasted nearly 3 billion gallons of gasoline in 1984 or about 4% of the annual consumption in the United States. The positive attributes of bicycling include; the reduced congestion on the roadways and parking areas, reduced energy consumption, reduced air pollution and improved personal physical fitness and quality of life.

2.39 Impact of the Automobile on the Built Environment

What is considered a pollutant depends upon the recognition of the substance (or substances) which cause adverse effects. There are two basic categories of air pollutants: primary and secondary. Primary pollutants such as carbon monoxide and hydrocarbons are directly released into the air from fuel combustion in stationary and mobile sources or from other processes. However, under the proper conditions, some of these undergo reactions and transformations in the atmosphere to produce secondary pollutants such as ozone and nitric acid.

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[1] Gisela Bolte, Thomas McCarroll and Edwin M. Reingold. "Gridlock! Congestion on America's Highways and Runways Takes a Grinding Toll", *Time* Vol.132. No.11. 12 September 1988, p.42.

[2] Winnipeg Free Press. "Project Aims to 'Educate' Roads to Communicate with Cars". 23 November 1988, p.39.

The gasoline-powered automobile is a source of four primary air pollutants: carbon monoxide, hydrocarbons, nitrogen and sulphur oxides. The hydrocarbon mixture generated by motor vehicles is complex, with over 300 identified compounds (Hampton et al., 1982).

The 1976 Canadian Emission Inventory revealed that the principal source of nitrogen oxide emissions were from gasoline-powered motor vehicles, 26.8% of the total and industrial combustion, 19.7% of the total. Vehicles were also found to be an important source of hydrocarbon emissions, 33.1% and a major contributor of carbon monoxide emissions, 46.6% of the total.

Every day thousands of tons of organic gases, oxides, and particulates are released into the atmosphere which are capable of damaging the well-being of living organisms. Air pollution comes from man-made and natural sources. The latter include smoke from forest fires, wind-blown dust and, on occasion, large-scale volcanic eruptions. Man-made sources include the fall-out of sulphur dioxide and other chemicals transported great distances in the upper atmosphere. The familiar sources of localized air pollution are motor vehicles, industrial and public utility smokestacks, and domestic chimneys. Sulphur dioxide, nitrogen oxides, particulate matter, hydrocarbons, and lead are not only hazards to human health but also have adverse affects on animals, agriculture, forest growth and building materials. The particular mix and concentration of air pollutants vary considerably from location to location and from day to day. The most important determinant of air quality at any given time is the combination of weather conditions, intensity of emissions, and location of sources. Air inversion over industrial sources are the most dramatic, but more subtle variations can be observed in periods of economic slowdown, or when shifts in lifestyle take place (e.g., increases in the number of wood-burning stoves). Table 15 summarizes the major contributors of air pollution as determined by the Environmental Protection Service of Environment Canada, in the 1980 nation-wide emissions inventory data. With regard to hydrocarbons, the major contributors were gasoline motor vehicles and various sectors of the petroleum industry. The largest contributors of nitrogen oxides were gasoline-powered motor vehicles, diesel engines, industrial fuel combustion and power utilities. The extraction of iron ore and the processing for vehicle parts were significant contributors to the level of particulate matter and sulphur oxides emitted yearly.

Table 15 Emissions Inventory of Air Contaminants, 1980

CONTAMINANTS	TOTAL EMISSIONS*	MAJOR CONTRIBUTORS by CATEGORY	%	MAJOR CONTRIBUTORS by SOURCE	%
Particulate Matter	1.9	Industrial Processes	64.0		
		Miscellaneous	12.9		
		Fuel Combustion/ Stationary Sources	16.2		
Sulphur Oxides SO_2	4.6	Industrial Processes	67.1		
		Fuel Combustion/ Stationary Sources	29.9		
Hydrocarbons	2.0	Industrial Processes	28.9		
		Transportation	40.3	Gas Vehicles	77.3
		Miscellaneous	25.8	Gas/Diesel	46.1
Nitrogen Oxides NO_2	1.7	Transportation	62.1	Gas Vehicles	42.1
				Diesel Engines	38.7
				Railroads	10.0
		Fuel Combustion/ Stationary Sources	33.8		

* in millions of tonnes
Source: Peter M. Bird and David J. Rapport, *State of the Environment Report for Canada*, p.213.

Estimates of nation-wide emissions of lead show that gasoline motor vehicles were by far the largest source of lead in the atmosphere. However, the increasing displacement of leaded by unleaded gasoline since the mid-1970s has contributed significantly to decreasing the quantity of lead emissions from this source. The level is expected to drop further when Federal legislation takes effect on 1 December 1990 that requires all lead be eliminated from gasoline. Since 1974 the annual ambient lead concentrations recorded in 1982 indicated a drop of 56% since 1974 (Bird and Rapport 1986:216).

There is direct and indirect evidence of an increasing number of toxins in the environment. Questions have been raised about the effect of these substances on human health. Over the years this concern has resulted in the establishment of exposure guidelines and standards designed to protect an individual's health. Setting guidelines or standards involves a number of considerations. These include determining the acceptable risk,

evaluating the type, rate and length of exposure, and establishing monitoring methods. Standards established for contaminants like carbon monoxide and hydrocarbons have been set to protect the vulnerable groups in the population - very young, very old, ill, etc. - whereas nitrogen dioxide and photochemical oxidants have been set with this in mind, but also to protect vegetation from damage like photochemical pollution and foliage deterioration.

Carbon monoxide, CO, is capable of deleterious effects on the cardiac function, as such, it is of greatest relevance to individuals with cardiovascular disease. It has been shown to have an adverse effect on work performance and the functions of the central nervous system. Impairment of vigilance or the performance of complex tasks are two of the side effects that may occur at low levels of CO exposure (R.J. Kolomeychuk et. al. 1984). This may be of significance to the general population, especially with respect to its possible influence on driving skills. Pregnant women, their unborn child and newborn babies all have an increased susceptibility to CO toxicity. CO levels on a freeway with traffic stopped may exceed 44 ppm, in a closed automobile where cigarettes are smoked, the level can reach 87 ppm, and on a heavily travelled vehicular tunnel the one hour maximum may exceed 218 ppm. The levels may increase higher if the roadway is heavily used or if it is lined with tall buildings, in an urban setting like this, the wind cannot penetrate to carry away the pollution. Carbon monoxide is the most familiar pollutant in exhaust. Carbon monoxide combines with hemoglobin, the oxygen-carrying molecule in the blood, to form carboxy-hemoglobin. Carbon monoxide has a 200-times-greater affinity for hemoglobin than oxygen. By occupying vital binding sites in a molecule of hemoglobin, CO impairs oxygen delivery to the blood, thus causing performance to decline. The Manitoba maximum acceptable 1-hour level of 35 ppm is sufficient to produce a blood carboxy-hemoglobin concentration of 1.5% (Burke 1988:80).

Exposure to Nitrogen Dioxide, NO_2, will affect an individual's sensory perception and cause irritation to the mucous membranes of the respiratory tract (R.J. Kolomeychuk et. al. 1984). The damaging effects of NO_2 on the function of the lungs is of particular relevance to asthmatics. It is also possible that NO_2 will increase a person's susceptibility to infection. Cities with long periods of cold weather tend to record high annual means of NO_2 concentration (e.g., Edmonton and Winnipeg).

Ozone is a secondary pollutant formed principally from the interaction of hydrocarbons and nitrogen oxides under certain meteorological conditions. Internal

combustion engines are the principal sources of hydrocarbons and nitrogen oxides. While ozone in the atmosphere is essential for life, it has been shown that prolonged exposure to high ozone concentrations in the lower atmosphere is harmful to the human respiratory system and to plant photosynthesis. Once created, it remains trapped until a major weather front clears the air. Ozone pollution is especially acute in warm-weather cities, recording high levels in the summer.

Ozone may induce abnormalities in various organs throughout the body. With the respiratory system as the site of greatest damage. Ozone impairs the function of the lungs, but the magnitude of the effect is dependent on a variety of factors, including individual susceptibility and level of exercise. Decreased performance, exacerbation of asthma, increased susceptibility to infection and excess respiratory disease hospital admissions have all been linked to ozone exposure. Studies have shown that the body adapts to continued exposure to ozone. Physiologists as yet, do not know if this is a healthy adaptation similar to the body's response to attitude and heat, or whether it's destructive at the cellular level and injurious over the long term (Burke 1988:80). Adaptation suggests that there is less constriction of the air passages, which means the ozone may be able to penetrate deeper into the lungs and cause damage.

Diesel exhaust is known to contain a high concentration of particulates. This has been linked to an increased mortality rate among elderly individuals and patients with respiratory diseases (chronic bronchitis, emphysema, etc.). Exposure to suspended particulates is also known to cause an exacerbation of disease in such patients, and studies have linked the frequency of asthma attacks and the incidence of acute respiratory disease in children with exposure to particulates (R.J. Kolomeychuk et. al. 1984). The major health concern regarding diesel emissions is its potential to be cancer-causing.

Hydrocarbons as a class provide little direct health effects at ambient levels (R.J. Kolomeychuk et. al. 1984). Some hydrocarbons, however, can be hazardous at levels approximating those found in the ambient air. Benzene, for example, is known to be capable of producing serious blood disorders, including leukemia. Aldehydes, such as formaldehyde, which may be formed from hydrocarbons emitted in automobile exhaust, may be irritating to the mucous membranes or cause asthmatic attacks in sensitive individuals.

Acid precipitation may indirectly effect an individual's health by increasing the risk of mercury poisoning, lead poisoning or intoxication from other elements in some areas and populations.

Studies of air pollutant effects on terrestrial systems have concentrated mainly on vegetation. Visible leaf injury is the most readily detected and most frequently reported symptom of exposure to NO_2. However, studies have shown that declines in plant growth and yield can occur without such symptoms necessarily being visible.

Available data suggests that ozone, O_3, is the most pervasive and economically damaging of the photochemical oxidants. Ozone effects on plants include metabolic alterations, reduced primary production, and subsequent changes in the partitioning of photosynthate and related reductions in biomass and/or yield. Additional effects include those that relate to plant quality, such as foliar injury or altered nutritional composition of crops. Current evidence suggests that ozone in ambient air in many areas of North America is currently sufficient to reduce the growth and yield of vegetation, and that sensitive crops are significantly affected by a 7-hour midday seasonal average O_3 concentration of 80 to 200 ug/m3 or 40 to 100 parts per billion (R.J. Kolomeychuk et. al. 1984).

Evidence exists which indicates that major portions of temperate forest ecosystems are undergoing perturbations related to oxidants, resulting in significant forest changes. Decreases in production and diversity are evident, with early and mid-successional forests being particularly endangered. Long-term continual stresses are thought to decrease total foliar cover and species richness and increase dominance by oxidant-tolerant species. Gradual and subtle changes over time in forest metabolism, growth and composition over wide areas of the temperate zone are thought by researchers to be much more important than the more dramatic destruction of forests in the immediate vicinity of point sources of oxidants over short periods.

Indirect Effects of Contaminants

Indirect effects are the formation of a secondary reaction product which itself has a direct effect on the environment. These indirect effects include the formation of photochemical oxidants from primary emissions of hydrocarbons and nitrogen oxides in the presence of sunlight and the formation of nitrates and nitric acid from emissions of nitrogen oxides. The resultant end products all have known or suspected adverse effects on various receptors in the environment.

Currently in Manitoba standards have been set to regulate the levels of pollutants. The values set are based on a maximum desirable level and a maximum acceptable level. The maximum acceptable level is intended to provide adequate protection against the effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being. The maximum desirable level is intended as a long-term goal for air quality as a basis for an anti-degradation policy in unpolluted areas of the country. Table 16 provides a summary for the contaminant levels in Manitoba.

Table 16 Contaminant Levels in Manitoba

	MAXIMUM DESIRABLE LEVEL	MAXIMUM ACCEPTABLE LEVEL
CARBON MONOXIDE mg/m3		
1 hour average	15 (13 ppm)	35 (31 ppm)
8 hour average	6 (5 ppm)	15 (13 ppm)
24 hour average		
OXIDANTS (OZONES) ug/m3		
1 hour average	100 (50 ppb)	160 (80 ppb)
24 hour average	30 (15 ppb)	50 (25 ppb)
Annual Arithmetic Mean		30 (15 ppb)
NITROGEN OXIDE ug/m3		
1 hour average	—	400 (210 ppb)
24 hour average	—	200 (110 ppb)
Annual Arithmetic Mean	60 (63 ppb)	100 (50 ppb)
HYDROCARBONS ug/m3		
3 hour average	125 (63 ppb)	160 (80 ppb)
PARTICULATE MATTER ug/m3		
Annual Geometric Mean	60 (30 ppb)	70 (35 ppb)
Average Concentration (over a 24 hour period)		120 (60 ppb)

Source: Peter M. Bird and David J. Rapport, *State of the Environment Report for Canada*, p.212.
ug/m3 = micrograms per cubic metre
mg/m3 = milligrams per cubic metre
ppm = parts per million
ppb = parts per billion

Table 17 illustrates the annual mean in Winnipeg for four contaminants during 1981. During that year, the 1 hour average for the maximum desirable level for ozone

concentration, 50 ppb, was exceeded 95 times. Similarly, the level for total suspended particulates was exceeded on 24 occasions.

Table 17 Annual Contaminant Means in Winnipeg, 1981

CONTAMINANT	ANNUAL MEAN
Carbon Monoxide	.90 ppm
Nitrogen Dioxide	21 ppb
Ozone	15 ppb
Suspended Particulates	55.0 ug/m3

Source: Peter M. Bird and David J. Rapport, *State of the Environment Report for Canada*, p.212.

It has been nearly 25 years since the first emission controls were instituted. Initially they were not much more than guidelines, to begin the study of controlling emissions. Today, many new cars produced are able to either improve or meet the required emission standards. Cars presently in operation that were manufactured prior to emission controls remain major sources of pollution. However, as these older cars are cycled out of the mix, and become replaced by newer more efficient vehicles, the contribution to the total pollution created by individual passenger cars will decrease. Table 18 lists three contaminants emitted by automobiles on a per mile driven basis. It states the levels for the years 1980 and 1985 and projects the estimated levels for the next fifteen years.

Table 18 Projected Vehicle Emissions
(grams/mile)

	1980			1985			1990			1995 &2000		
	NOx	HC	CO	NOx	HC	CO	NOx	HC	CO	NOx	HC	CO
Cars	2.80	3.78	36.22	2.42	2.32	28.79	2.31	1.78	29.11	2.31	1.63	28.52
Trucks	3.75	3.97	54.97	3.03	2.58	31.72	2.65	2.21	26.94	2.65	2.21	26.94

Source: C.S. Davis et. al., *Proposed Automobile Emission Standards on Air Quality Assessment*, p.4.15.
NOx = Nitrogen Oxides
HC = Hydrocarbons
CO = Carbon Monoxide

Frequent studies have been conducted in an attempt to determine the effects pollution has on city residents. In 1977 the United States Department of Transportation selected ten male cyclists for a pollution study. Also selected was a control group who travelled the identical routes but exclusively in an automobile. The test routes covered a selection of streets and commuter routes in and around Washington, D.C. They included trips of both 30 and 60 minute duration to expose the participants to a variety of conditions

common to peak traffic hours. Before each run, all participants were tested for blood levels of carboxy-hemoglobin, carbon monoxide, in addition to numerous other pollutants. After each run, the rider/driver was tested for eleven signs and symptoms that could reveal the effects of air pollution on their health.

The report began by stating, "that no major adverse short-term health effects were noted while bicycling or driving in levels of pollution and thermal stress, during the testing period" (Marshall 1981:138). Furthermore, the study also discovered that both; motorists in the control group and the bicyclists, built up similar levels of carbon monoxide during the test runs. The test evidence however, did indicate that bicyclists are far less likely to suffer any ill effects from lead, sulphur oxides, nitrogen oxides and carbon monoxide when the cycling trails are separated from the roadway be even 30 to 50 feet. As such, the report recommends that cyclists should limit their exposure to pollutants by travelling during non-peak traffic times, selecting adjacent, secondary routes with less traffic or separate pathways if available.

Carbon monoxide levels in urban traffic can average more than 50 ppm, peaking at approximately 100 ppm at stop lights/signs. These high levels may extend as far as 50 feet from the main stream of traffic. Even moderate traffic conditions can result in CO levels of 30 ppm. Wind speed and the direction can affect carbon monoxide concentrations. For instance, a headwind or tailwind usually means higher levels, while a crosswind tends to dissipate much of the pollution. During the latter condition, riding on the upwind side of the road can make a large difference in the degree of exposure.

Seasons of the year also affect the concentration of this pollutant. CO levels are generally higher during winter because: cold engines produce higher concentrations of the gas; the use of other fuels for heat adds to the emission totals; and, the winds are generally lighter. The levels also vary with the time of day. In most cities the heaviest traffic occurs during the morning and evening commuter hours and subsequently the levels are higher.

One recent study illustrates the detrimental effects of carbon monoxide on performance. In the experiment, non-smokers were instructed to exercise while being subjected to an environment with clean air and an environment that possessed a carbon monoxide concentration of 100 ppm. The carboxy-hemoglobin levels, while exercising at maximum output on a treadmill, rose from 1.7% to 3.9% in one hour. This resulted in a

decrease in exercise time from 698 to 663 seconds (Burke 1988:81). As such, CO levels near heavily travelled roadways can negatively affect cycling performance and comfort.

Ozone pollution, as noted previously, may cause damage to the respiratory system. Research during the mid-1970s showed that high ozone concentrations inhibit performance. In studies conducted at the University of California, participants engaged in strenuous exercise after being exposed to conditions simulating an average-to-bad air quality day in Los Angeles.. After just one hour of exposure they could not complete a 60 minute exercise test, nor could they perform maximally. Frequent complaints included chest pain, nausea, headache and shortness of breath (Burke 1988:80). In actual conditions, the effects could be made worse because of the heat and compounded effects of other pollutants.

A more recent study conducted at the UCLA School of Medicine reported similar results. The study exposed 17 top-level road cyclists to varying levels of ozone (0.00, 0.12 and 0.20 ppm) while riding a stationary bicycle for 60 minutes in an 88 degree Fahrenheit chamber. Their breathing and ability to maintain a high cadence were significantly impaired at the 0.20 ppm O_3 level. In this atmosphere, significant discomfort and short-term damage may occur. The riders in the study were not significantly affected by lower levels of ozone, although they did experience some lung impairment and mild discomfort. Thus, the report concludes that the threshold for significant impairment of performance appears to be between 0.12 and 0.20 ppm of ozone (Burke 1988:79).

The metals used in vehicles are non-renewable resources, extracted from ores through the expenditure of large quantities of energy, and a variety of environmental costs are incurred: air pollution emitted at the mine and smelter and the destruction of ecosystems at the mine site from building roads, extraction methods and dumping overburden. The long list of side effects flowing from the use of automobiles include: the environmental costs of petroleum extraction, refining and transport; the pollution and ecosystem destruction from building roads, bridges, parking garages, shopping centres, gas stations; and exhausts that contribute to eye irritation, emphysema, and lung cancer, in addition to acid rain and the greenhouse effect.

Ecosystems supply civilization with public services that are irreplaceable and inextricably embedded in the life-support system. They include the regulation of climate and the makeup of the atmosphere, generation and maintenance of soils, control of potential

crop pests and carriers of human diseases, pollination of many crops, and provision of food from the sea. Ecosystems supply the nutrients without which mankind could not survive, and in the process they dispose of the wastes generated.

There has been a continual rise in atmospheric levels of the gases carbon dioxide and methane. These *greenhouse* gases trap heat near the earth's surface and thus alter the climate. Major sources of increased CO_2 are the burning of fossil fuels - clearly related to a country's affluence - and the destruction of forests. While rapid population growth in poor countries impedes the escape from poverty and often leads to local environmental deterioration, overpopulation and resource consumption in rich nations threatens the earth's capacity to sustain everyone. A person in a developed country, like the United States, imposes a disproportionate amount of stress on the world's resources and environment than a person in a developing country. Their lifestyles do not require huge quantities of minerals and energy, nor do their activities seriously undermine the life-support capability of the entire planet. They do not own automobiles or air-conditioners or consume grain-fed beef. Table 19 compares The People's Republic of China with the United States with regard to the energy consumed. The United States is currently the single greatest contributor of contaminants on a global scale. While only one-quarter of the population of China, the U.S. consumes almost 350% more energy.

Table 19 Energy Consumption

	1988 Population	Number of Automobiles registered 1986	Energy Consumed Per Person U.N. Standard Barrels of Oil	Total Energy Consumed
United States	246 Million	135 Million	45	**11 Billion**
China*	1 100 Million	761 000	3	**3.3 Billion**

Source: Paul R. Ehrlich, *National Geographic*, p. 942.
Average amount of energy consumed per person per year (primary types of energy, excluding firewood and crop residues, are converted to oil equivalents).
* In China there is widespread use of coal at the household level, because it is inexpensive and China contains huge reserves, however the resulting consequence is severe pollution and acid rain.

The ominous threat to agriculture and natural ecosystems are human-induced changes in climate projected to result from additions to the atmosphere of trace gases, the result will be the worsening of the greenhouse effect. Extremes in weather usually result in crop losses - as the drought this past summer and heat wave in the North America grain belt clearly demonstrated. While it can not be conclusively shown that the 1988 drought was

caused by climate change induced by the greenhouse effect, scientists point out that it was typical of the unusual weather expected to become more frequent as the greenhouse gases build up. Crop losses in North America's farm belt are a disaster for the world; the region is the chief supplier of a world grain market on which roughly a hundred other nations depend (Ehrlich 1988:940).

To date, over 3.88 million miles of roads have been constructed in the United States. However, many traffic experts believe it unlikely that enough new highways can be built to alleviate the transportation problems. In the cities, making traffic flow on streets and expressways more efficiently already consumes much of the time of traffic planers. Special bus and car-pool lanes, changes in the timing of stop lights, parking bans and controls at freeway entrance ramps are all intended to move as many people as quickly as possible, particularly in rush hour. These approaches are based on studying past traffic patterns but they cannot cope with an unexpected accident or the breakdown of a vehicle. Whereas the approach to transportation planning in developing countries is fundamentally different by virtually excluding the private automobile. The policies employed in China are typical of those found in many of the overpopulated and overcrowded cities in third world nations. Chinese transportation planning policies have been developed through innovative solutions, by combining mass public transport with mass private personal transport. The potential is to avoid the motor car and thus avoid the extremely expensive and often environmentally damaging solutions that are necessary when catering to the motor car - urban motorways, land acquisition and multi-storey car parks. Major resources saved could be channeled into developing high quality public transport systems. Personal transportation would continue to take the form of cheap and highly popular bicycles. In the Northern Chinese Capital of Beijing, there were 9 million residents recorded in 1982, of which 4 million owned bicycles.

The U.S. Transportation Department study revealed that local commuters generally move in and out of the downtown area in a radial pattern, along the paths of mass transit and major thoroughfares. However, the study discovered that the historical site for job concentration, the city centre, has been losing ground to the suburbs. In the U.S. the suburbs contain 60% of all current metropolitan jobs and 67% of all new jobs created. The result has been for workers to commute from one suburb to another, this has led to extreme crowding along these routes because mass transit and the road network are not that well-developed to accommodate this unexpected and unplanned load. In Winnipeg, this trend can also be traced. The downtown was once thought to possess the highest concentration

of employment opportunities, yet this role has steadily diminished, while jobs in the outlying areas has proliferated. The city centre still contains the highest, single concentration of jobs with 26% of the total. But this has dropped considerably since 1962 when it had over 40%. Concurrently the suburbs have doubled their total number of jobs in 14 years, to 28% in 1986. The area immediately adjacent to the downtown has remained constant over this period with 45% of the total.[1]

2.40 Reclamation of Lands for Trail Use

A recent Fitness Canada study has shown that bicycling has become the most popular form of outdoor activity in the country. The Canadian Cycling Association estimates that nearly one-third, or 8 Million Canadians cycle. In addition, sports like jogging, hiking, walking and cross-country skiing have all been increasing in popularity. The trend in urban environments is to incorporate outdoor recreation, especially fitness-oriented activities, into everyday life. An urban trail or recreational pathway is an ideal setting for these activities. It is essentially a linear park that is separated from the roadway and utilizes a variety of corridors. These corridors may take the form of a river bank, transmission lines, pipe lines, irrigation canals, road right-of-ways, drainageways and abandoned rail lines. In establishing a pathway one of the main concerns is the complexity of the route's ownership, additional criteria include, access to open space, scenery and neighbourhood linkages. However, in a society so committed to motorized transportation, a recreational pathway is seen by some as a non-necessity.

Abandoned Rail Lines

In the early 1900s Winnipeg was known as the Gateway to the West, regarded for its role as a transportation centre. The train had become an integral part of Winnipeg's history. Since then conditions have changed considerably, to the point where this role is no longer as prominent. Trains are among the most energy efficient transportation modes ever developed. Their environmental impact is far less than that of trucks and buses. Trains excel at high-volume, long-distance bulk shipping, especially for commodities like coal and grain. But they are too slow and cumbersome to compete for many kinds of freight that once moved in box cars. Instead, it is now delivered straight to the customer's door by the semi-trailers. To compete, the railways are concentrating on their strong point - the heavily used main lines. Canadian National Railway estimates that the busiest one-third of its tracks carry almost 90% of its traffic and the bottom one-third constitutes only

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[1] City of Winnipeg, *Travel and Demographic Trends 1962- 1986*, p.9.

1%. Canadian Pacific Railway estimates that the least used-half of its track handles only 3% of its total traffic.[1]

Currently there is over 4 000 kilometres of main track line in Manitoba owned by CN Rail, add to this almost 2 900 kilometres of rail lines that are owned by CP Rail for a province-wide total of just under 7 000 kilometres. This figure has steadily been decreasing as both companies abandon unused and unprofitable rail lines. The New Transportation Act allows for the deregulation of the industry. The laws it created enable the companies to respond to profit and loss as other businesses do. At one time they had to prove at public hearings that the branch lines they wanted to close would never again turn a profit and that abandoning them wouldn't have adverse effects on the public. Now the railways can abandon up to four percent of their tracks each year for the next five years, without public hearings, if there is no public opposition.

CN Rail and CP Rail have taken advantage of this new proposition by abandoning lines at a combined rate of about 840 kilometres a year since 1975. However, 1988 will go down as a benchmark year: for it is the year that the island of Newfoundland lost its entire railway network. As a compromise the island will receive hundreds of millions of dollars to finance road development and upgrading. In Manitoba, the two rail companies have abandoned approximately 330 kilometres of line since 1978. The current situation of abandonment has been fortuitous for proponents of urban pathways. Land that has been in use for years, preserved from developmental pressures in congested cities, suddenly becomes available.

The response to rail abandonment in the United States has been the formation of an organization called Rails-to-Trails Conservancy. Their mandate, as the name implies, is to develop abandoned rail lines into linear parks. Support for this concept has been growing. Formed only two years age with zero members, the organization has flourished, and membership now rests at 7 000. Each member joins for their own reason, some because they are interested in recreation, others because of the environment or some for the historical aspect of it. There now exists a growing network of some 160 trails, all built on abandoned railroad right-of-ways, covering more than 3 200 kilometres in 28 states. Eventually the Washington-based conservancy hopes to establish extensive and diverse trails in every state. Their short-term goal is to create 500 trails by 1992. This is very

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[1] "End of the Line", Winnipeg Free Press, 10 September 1988, p.18.

possible considering the degree of abandonment south of the border. Back in 1916, at the height of the railroading era, the United States had more than 270 000 miles of track. But changing economics and politics in the U.S. have led to a major contraction of the rail network. Over 125 000 miles of track have already gone out of service and thousands more are in such marginal use that they are likely to be abandoned in the near future.

The conversion process is fractious and slow: it took 12 years, for example, to complete the 70 kilometre long Washington and Old Dominion Railroad Regional Park. Common obstacles are recalcitrant landowners, right-of-way disputes, jurisdictional wrangles, and money shortages. Few proposals ever reach development, chances are far greater that the abandoned land will be taken over by developers, highway builders or farmers. The organization placates opposition by arguing that a trail is beneficial both environmentally and economically. A 1987 study on the effects of the 20 kilometre Burke-Gilman Trail in Seattle, Washington concluded that property values near the trail have risen, and burglaries and vandalism of adjacent homes were well below the neighbourhood average.[1] This is in spite of the trail being the second busiest trail in the United States with usage around 750 000 people annually, averaging 7 000 users during the weekend. Wisconsin's Sugar River Trail showed that trail users spend between $400 000 and $600 000 US, along the route every year.

As a result the U.S. is experiencing a growing national movement to convert these valuable right-of-ways into public trails for running, walking, bicycling, wildlife conservation and observation, cross-country skiing, horseback riding among other activities. With the built rail system shrinking in Manitoba, abandoned rail corridors are becoming available for the development into recreational pathways. Figure 13 illustrates the network of lines that currently exists within the city boundaries. Some have been closed while others are being contemplated. A recently closed rail line in West Kildonan was sold to developers who converted the land into a residential and commercial linear development.

Although not every abandoned rail corridor is suitable, many routes have attributes that make for outstanding trails. For instance:

- Rail corridors are flat or have gentle slopes. As such rail trails are appealing to those with mobility impairments. They are also year-round facilities, being well-suited to cross-country skiing, snowshoeing and other winter activities.

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[1] Mercer Cross, Winnipeg Free Press, 7 May 1988, p.4A.

FIGURE 13 RAIL LINE LOCATION

Source:*City of Winnipeg Map.*

- Rail corridors offer exposure to many types of environments. Rail lines traverse urban lands to suburban to rural, including farmland, river valleys, wetlands, industrial areas, residential tracts, forests and lakeshores. Often the same right-of-way will pass through several of these different environments within a five- or ten-mile stretch.

- Rail corridors often include or are adjacent to historic structures such as railway stations, bridges, tunnels, mills, factories and canals. All of which enhance the trail user's experience.

- Rail corridors may be wildlife breeding and conservation areas with collections of birds, small mammals and plants. They often act to prevent soil and wind erosion.

- Rail corridors can represent a financial bargain to a community, with the price of a right-of-way amounting to only a fraction of the comparable cost of assembling a continuous corridor through a crowded and fragmented urban or suburban area. Moreover, some agencies and organizations may be able to obtain rail lines through donations or tax default without having to purchase the land at all.

- Rail corridors act as linear greenways through urban areas serving as buffers between incompatible adjacent land uses (such as residential and industrial) as well as providing recreational open space in otherwise crowded environments.

- Rail-trails are being shown to increase property values of homes nearby since a significant number of people will pay more to have a walking, running and bicycling trail in their neighbourhood. In the U.S. many real estate agents display advertisements extolling the close proximity to the popular trails, like the Burke-Gilman Trail, Illinois Prairie Path or W&OD Railroad Trail, as a special amenity of the house being sold.

- In rural areas, particularly those hard hit by the impact of railroad abandonments, a rail trail can be a significant stimulus to a local economy, with trail users spending money on food, beverages, camping, hotels, bed-and-breakfasts, bicycle rental, crafts, souvenirs and gasoline. As mentioned previously, trail users of Wisconsin's Sugar River Trail spend between $400 000 and $600 000US per year along the route. A 1985 survey Washington's Burke-Gilman Trail found the median income of trail users was $34 000.

- Rail corridors can link isolated park fragments, turning a disorganized system of unplanned open space into an integrated, multi-purpose recreation system.

- Rail corridors are good as rail corridors. Many routes in the U.S. are being used as interim trails to "bank" the land in case the economics of railroading changes and trains come back.

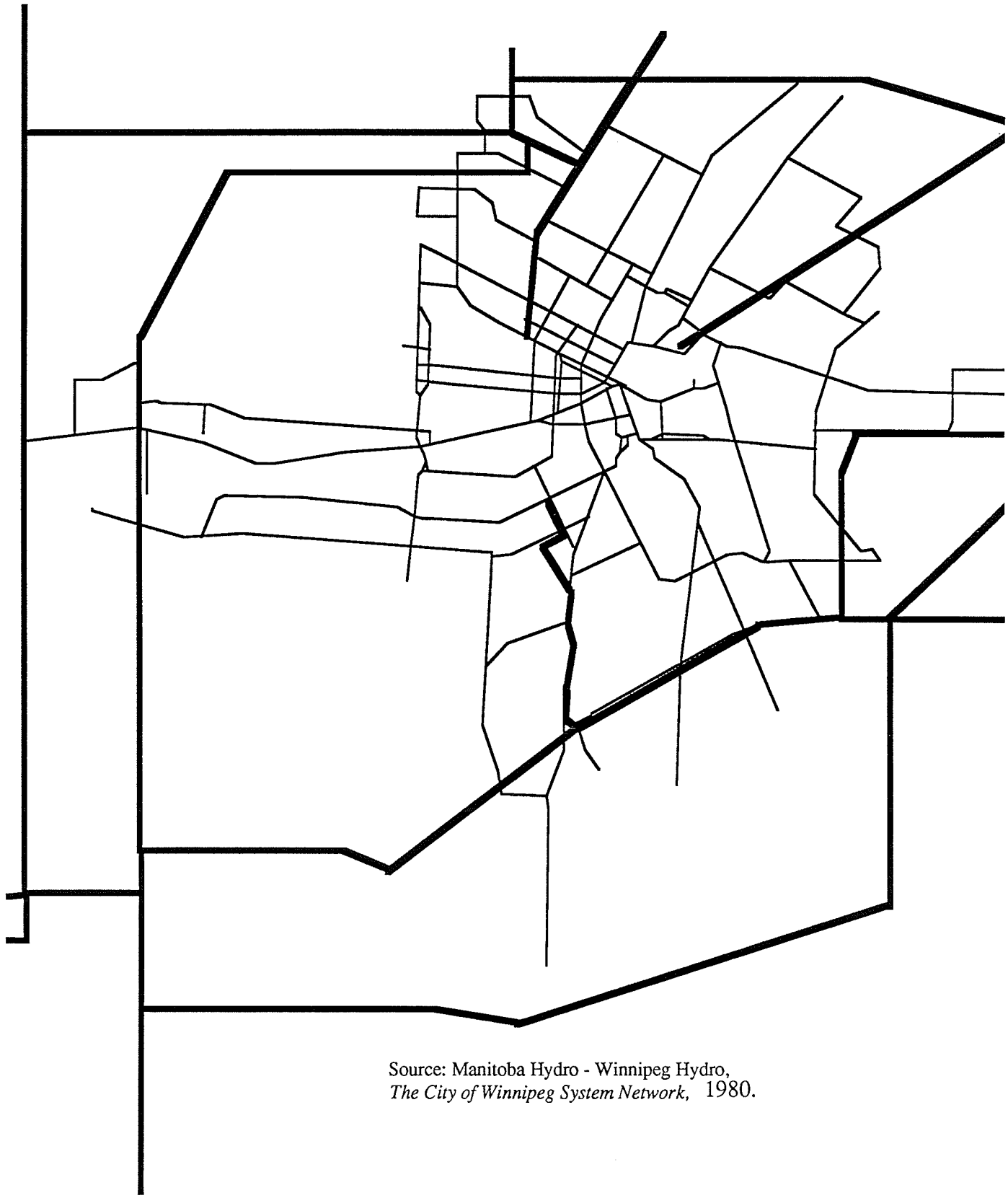
Transmission Lines

The potential exists to use land available under the transmission towers that carry Winnipeg's electrical needs into the city. In many instances this land is sitting idle and penetrates into the heart of the city. Figure 14 shows the location of transmission lines

within Winnipeg boundaries that have a wide enough right-of-way and overhead clearance to permit bicycle trails. This land possesses many of the same attributes that rail corridors have, ie., they are long, continuous and relatively flat. In addition they have a minimal amount of cross-traffic. They can be used as trails themselves or to link parks and other trails.

Winnipeg has yet to define a positive role for the bicycle within the context of its transportation policies. Many Canadian cities (see Chapter Four) have adopted policies that encourage and expand bicycle use with a commitment to finance the physical component of bike planning. This has resulted in the bicycle becoming an accepted and alternative mode of transportation for numerous city residents in these cities. This chapter has illustrated the prominent role that the bike once garnered in Winnipeg. But over time this position was allowed to deteriorate and current city policy has relegated its position to that of recreational status. To exploit the positive benefits of the bicycle it is necessary to first, ensure that there is the financial support from the government to build the projects and secondly, to formulate a bike master plan for the community. This chapter has provided the rationale and justification for creating a city-wide bicycle network and chapter three introduces the design criteria required to accomplish this task.

FIGURE 14 TRANSMISSION LINE RIGHT-OF-WAYS



Source: Manitoba Hydro - Winnipeg Hydro,
The City of Winnipeg System Network, 1980.

CHAPTER THREE
BICYCLE TRANSPORTATION NETWORK

Increased bicycle use for commuting and recreation can provide enjoyment, improve public health, reduce air pollution, traffic congestion, energy consumption and the cost of personal transportation. The many benefits of bicycling, both personal and to society, provide the justification for local, provincial and federal governments to give increased attention to the bicycle as a legitimate mode of transportation. Chapter Three provides a compilation of the most recent and innovative design criteria for the construction of bikeways. This criteria includes provisions for both the recreational and utilitarian cyclist. The concluding section of the chapter is an indepth analysis of cycling accidents in Manitoba. The analysis illustrates the groups at higher risk, the safety programs currently available and the types of conditions which lead to the accident. This critique provides the knowledge necessary to allow for the modification of the current safety, education and enforcement programs to address the most prevalent causes of accidents in the province.

3.1 BICYCLE FACILITIES DEVELOPMENT

Bicycle planning is commonly thought of as the effort undertaken to develop a bikeway system - a system of bike paths, bike lanes and bike routes - all interconnected and spaced closely enough to almost totally satisfy the travel needs of bicyclists. In fact, no such system could adequately provide for the vast majority of bicycle travel. Currently most bike travel is done on the city's road network and this will, in all likelihood, continue despite the provision of bicycle facilities. Bicyclists, even more so than motorists, seek the most direct routes from where they are to where they want to go, particularly those who use the bicycle for more than casual recreation. Because of the diversity of needs of bicyclists, and the fact that many trips are quite short, a bikeway system could not provide for most bicycle travel unless it were of the same detail as the street system. For this reason, roads, together with bikeways, must serve as the bicycle transit system to provide for the travel needs of bicyclists.

Bicycle planning is more accurately defined as the effort undertaken to provide for safe and efficient bicycle travel. Appropriately designed and located bicycle facilities play an important role in encouraging safe bicycle travel. Most roadways are sufficient to

accommodate shared use by bicyclists and motorists, and hence, most bicycle travel has occurred, and will likely continue to occur on that system. However, bicycle facility needs include not only the roadway lane or surface on which bicycles travel, but appropriate signage, control devices, parking facilities, and other support facilities. Access, personal safety, bicycle security and a comfortable riding environment are all necessary elements in a bicycle facility system.

Probably the most important effort that could be undertaken to enhance bicycle travel would be the improved maintenance and upgrading of the existing roads that are used regularly by bicyclists, regardless of whether or not bikeways are designated. This effort requires that increased attention be given to the right-hand portion of roadways where bicyclists are expected to ride. An attempt should be made to improve the width and quality of the surface and to maintain the right-hand portion in a condition suitable for bicycle riding. It is of paramount importance that consideration of bicycle needs be included in the implementation of major construction projects and normal safety and operational improvements. For example, in constructing new roads, adequate width should be provided to permit shared use by motorists and bicyclists. When resurfacing, the entire shoulder should be resurfaced as well as traffic lanes. When constructing truck passing lanes, the paved shoulders should not be sacrificed, causing bicyclists to ride within a truck lane. When placing a roadway edge stripe, an attempt should be made to provide sufficient room outside the stripe for bicyclists. When considering the restriping of roadways for more traffic lanes, the impact on bicycle travel should be assessed. These efforts to preserve or improve an area for bicyclists to ride, can benefit motorists as well as bicyclists.

In order to take maximum advantage of the opportunities for bicycling, bicycle planning should become an integral part of the planning for other transportation modes and land use development. Only through this effort can adequate provisions for bicycle parking and transit interface (e.g. park and ride facilities, "bikes on buses", parking at transit terminals) be assured.

3.11 The Role of Bikeways

Bikeways are one element of an effort to improve bicycling safety and convenience - either to help accommodate motor vehicle and bicycle traffic on shared roadways, or to complement the road system to meet the needs not adequately met by roads. Off-street bike paths in exclusive corridors can be effective in providing new recreational

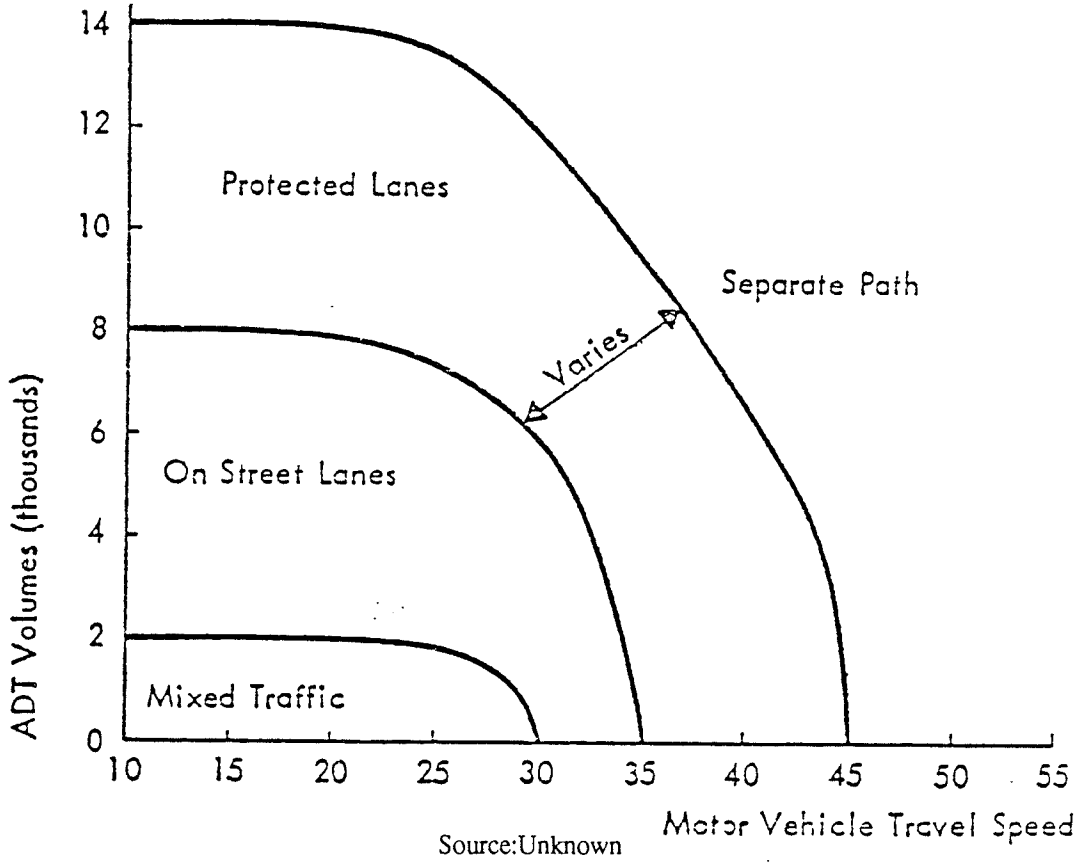
opportunities, or in some instances, desirable commuter routes. They can also be used to close gaps where barriers exist to bicycle travel (e.g. river crossings). On-street bikeways can serve to enhance safety and convenience especially if other commitments are made in conjunction with the establishment of bikeways, such as: the elimination of parking or increasing roadway width; elimination of surface irregularities and roadway obstacles; frequent street sweepings; establishing intersection priority on the bike route street as compared with the majority of cross streets; and the installation of bicycle sensitive loop detectors at signalized intersections.

In the transportation planning process, master plans should be developed to respond to the needs of bicyclists. Master plans, to be effective, must be based upon a comprehensive study of bicyclists' needs. This requires that bicyclists (both recreational and utilitarian) be involved in the identification of problems and the development of solutions. The effort involves a recognition that bikeways are only one necessary element within this process, and that the proper application of bikeways is essential to their effectiveness in responding to bicyclists' needs. Master plans should include actions necessary to ensure bicycle travel for utility purposes is feasible (e.g. secure parking facilities, transit interface, etc.). Poorly conceived and located facilities will frequently not be used by bicyclists. A facility that is not used may be labelled a waste of public funds.

The selection process for the development of bike facilities should be governed by the principle that facilities should not encourage bicycle or motor vehicle use in a manner contrary to the normal rules of the road. Adherence to this principle enhances both user safety and convenience.

One important consideration in selecting the type of facility is continuity. Alternating segments of bike paths and bike lanes (or bike routes) along a route are generally incompatible, as street crossings by bicyclists are required when the route changes character. Also, wrong-way bicycle travel will occur on the street beyond the ends of bike paths because of the inconvenience of having to cross the street. A second consideration is that the type of bike facilities required, will be a function of the type of roadway. Figure 15 illustrates the appropriate bike facilities as a function of automobile volumes and speed. The result being an increase in the level of safety for the bicyclists.

FIGURE 15 RELATIONSHIP of MOTOR VEHICLE SPEED VOLUMES to BICYCLE FACILITY REQUIREMENTS



Source:Unknown

The relationship between the type of facility and roadway function is the first step in deciding what bicycle facility options are available given the existing functional classification of the roadway network. Once these options have been identified however, each facility/roadway function combination must be further evaluated in terms of a number of location and design criteria such as, traffic volumes and speeds, truck and bus traffic, street widths, on-street parking, etc.

3.12 Bicycle Paths

Generally, bike paths, designated Class I, should be used to serve corridors not served by streets and highways or where wide right-of-ways exist permitting such facilities to be constructed away from the influence of parallel streets. Bike paths should offer opportunities not provided by the road system. They can either provide a recreational opportunity or, in some instances, can serve as direct high-speed commuter routes, if the cross flow by motor vehicles can be minimized. The more common locations are along rivers, canals, utility right-of-ways, abandoned rail lines, within college campuses, or

within and between parks. There may also be situations where such facilities can be provided as part of planned developments. Another frequent application is to eliminate impediments to bicycle travel caused by the construction of freeways, or because of the existence of natural barriers.

In some cases, bike paths could also be accommodated within the Provincial highway right-of-ways, assuming that applicable laws permit and that criteria for bicycle and motorized traffic separation and compliance with the normal rules of the road are met. Right-of-way widths would have to be such that adequate room exists for the separated facilities.

3.13 Bicycle Lanes

Bicycle lanes or Class II facilities, are a portion of the roadway which has been designated for the preferential or exclusive use of bicyclists. This designation includes striped bike lanes, paved shoulders, and lanes for joint use by bicycles and disabled motor vehicles.

Bike lanes are established along streets in corridors where there is significant bicycle demand, and where there are distinct needs that can be served by them. The purpose should be to improve conditions for bicyclists in the corridors and to better accommodate bicyclists through corridors with insufficient room for safe bicycling on existing streets. Bike lanes are desirable when traffic volumes or speeds are such that wide curb-lanes are not practical. Other corridors that may warrant bike lanes include:

1 Corridors with heavy bicycle traffic, where bicyclists must frequently pass each other travelling in the same direction.

2 Insufficiently lighted corridors on which frequent nighttime usage is expected. e.g. those with a nighttime entertainment/shopping/ educational/recreational centre as a common destination.

3 Corridors on which lane designation is not complicated by frequent residential or commercial driveways or roadway intersections.

Additional measures that might not be possible on all streets, must be implemented on bike lane streets to improve the situation for bicyclists (e.g. pavement surface improvements, stronger sweeping programs, special signal facilities, etc.). Special efforts should be made to ensure that high levels of service are provided with these lanes (i.e. bicycle-sensitive signal actuators, pavement markings, etc.), if bicycle travel is to be

regulated by delineation. Additional night lighting of extensively travelled bicycle corridors also increases safety and comfort.

Bicycle lanes can be provided by widening existing roadways, paving shoulder areas, eliminating parking, or using emergency lanes for disabled vehicles. The selection of the proper type of bike facility can be made in the context of a thorough understanding of the following factors.

	ARGUMENTS FOR	ARGUMENTS AGAINST
CLASS I - Separate Path		
	Good for leisure recreation.	Higher costs.
	Peaceful ride away from noise and congestion.	Increased maintenance.
	Peace of mind from a safety standpoint.	Problems at terminals.
CLASS II - On Sidewalk		
	Lower cost.	Increased accident rate.[1]
	May be only alternative in	Intersection problems.
	existing condition.	Conflicts with pedestrians.
		In residential areas, smooth travel
		interrupted by toys, children playing, etc.
CLASS II - On Street		
	Assigns space on road.	Right-turn conflict.
	Desired by most cyclists.	Bike space not clean enough.
	Alternatives usually more expensive.	False sense of security.
	Shared by all modes of transportation.	
	System continuity easier to maintain.	

3.14 Wide Curb Lanes

Similar to bike lanes, wide curb lanes are placed along streets in corridors where there is significant bicycle demand. Unlike bicycle lanes, however, wide curb lanes are for shared use by bicycle and motorized traffic. The added lane width provides greater room for manoeuvering and increases the lateral distance between bicyclists and vehicles.

[1] Palo Alto, California and Eugene, Oregon both experienced dramatic increases when this experiment was implemented.

Wide curb lanes are appropriate bicycle facilities where traffic speeds and volumes are tolerable for shared roadway facilities. Wide curb lane facilities are selected when there is insufficient room for a separate bike lane, yet significant demand exists for providing a facility of some kind. To many experienced riders, wide curb lanes are a preferred facility type because it integrates bicycle and vehicular traffic, and forces recognition and awareness on the part of the motorist. Wide curb lane facilities can be created by widening roadways, by narrowing traffic lanes, or a combination of the two.

3.15 Bicycle Routes

Bike routes or Class III bikeways are shared facilities which serve either to:

i provide continuity to other bicycle facilities (usually bike lanes); or

ii designate preferred routes through high-demand corridors.

As with bike lanes, designation of bike routes should indicate to bicyclists that there are particular advantages to using these routes as compared with alternative routes. This means that appropriate agencies have taken actions to ensure that these routes are suitable as shared routes and will be maintained in a manner consistent with the needs of bicyclists. Normally bike routes are shared with motor vehicles.

3.16 Shared Roadways (No Bikeway Designation)

Most bicycle travel now occurs on streets and highways without bikeway designation. This will probably be true in the future as well. In some instances, entire street systems may be fully adequate for safe and efficient bicycle travel, and signing and striping for bicycle use may be unnecessary. In other cases, a street may be inherently unsafe for bicycle travel and it would be inappropriate to encourage additional bicycle travel by designating the street as a bikeway.

Many rural highways are used by touring bicyclists for inter-city and recreational travel. In most cases, it would be inappropriate to designate the highways as bikeways if it is expected to have limited use or if it lacks continuity with other bike routes.

3.2 ROADWAY IMPROVEMENTS

There is a wide range of facility improvements which can enhance bicycle transportation. Improvements can be simple and involve minimal design considerations (e.g., changing drainage grate inlets) or they can involve a detailed design (e.g., providing a bicycle path). The controlling feature of the design of every bicycle facility is its location (i.e., whether it is on the roadway or on an independent alignment). Roadway

improvements such as bicycle lanes depend on the roadway's design. On the other hand, bicycle paths are located on independent alignments; consequently, their design depends on many factors, including the performance capabilities of the bicyclists and the bicycle.

Improvements for motor vehicles through appropriate planning and design can enhance bicycle travel and in any event should avoid adverse impacts on bicycling. The overall goal for any transportation improvements should, wherever possible, include the enhancement of bicycling.

To varying extents, bicycles will be ridden on all highways where they are permitted. All new highways, except those where bicyclists will be legally prohibited, should be designed and constructed under the assumption that they will be used by bicyclists. Bicycle safe design practices should be followed to avoid the necessity for costly remedial improvements. Because most highways have not been designed with bicycle travel in mind, there are often many ways in which roadways can be improved to more safely accommodate bicycle traffic. Roadway conditions should be examined and, where necessary, safe drainage grates and railroad crossings, smooth pavements, and signals responsive to bicycles should be provided. In addition, the desirability of adding facilities such as bicycle lanes, bicycle routes, shoulder improvements, and wide curb-lanes should be considered.

3.21 Drainage Grates

Drainage grate inlets and utility covers are potential problems to bicyclists. When a new roadway is designed, all such grates and covers should be kept out of the bicyclists expected path, if possible. On new construction where bicyclists will be permitted, curb inlets should be used, where possible, to completely eliminate exposure of grate inlets to bicyclists. It is important that grates and utility covers be adjusted flush with the surface, including after a roadway is resurfaced.

Parallel bar drainage grate inlets can trap the front wheel of a bicycle causing loss of steering control and, quite often, the bar spacing is such that they allow narrow bicycle wheels to drop into the grates, resulting in serious damage to the bicycle wheel and frame and/or injury to the bicyclist. It is mandatory that these grates be replaced with bicycle-safe varieties. In the interim, when this is not immediately possible, steel cross straps or bars should be welded perpendicular to the parallel bars to provide a maximum safe opening between straps. However, this should be considered as only a temporary correction.

All drainage grates should be clearly marked so they become visible to travelling bicyclists. Due to the serious consequences of a bicyclist travelling over a parallel bar grate inlet by missing the pavement marking in the dark or being forced over such a grate by other traffic, these grates should be physically corrected as soon as possible, as pavement marking is inadequate.

3.22 Railroad Crossings

Railroad highway grade crossings should ideally be at right angles to the rails. The greater the crossing deviates from this ideal crossing angle, the greater the potential is for a bicyclists front wheel to be trapped in the flangeway causing loss of steering control. It is also important that the roadway approach be at the same elevation as the rails.

Consideration should be given to the materials of the crossing surface and to the flangeway depth and width. If the crossing angle is less than approximately 45 degrees, consideration should be given to widening the outside lane, shoulder, or bicycle lane to allow bicyclists adequate room to cross the tracks at a right angle (See Figure 16). Where this is not possible, commercially available compressible, rubber flangeway fillers can enhance bicyclists safety. In some cases, abandoned tracks can be removed. Warning signs and pavement markings should be installed.

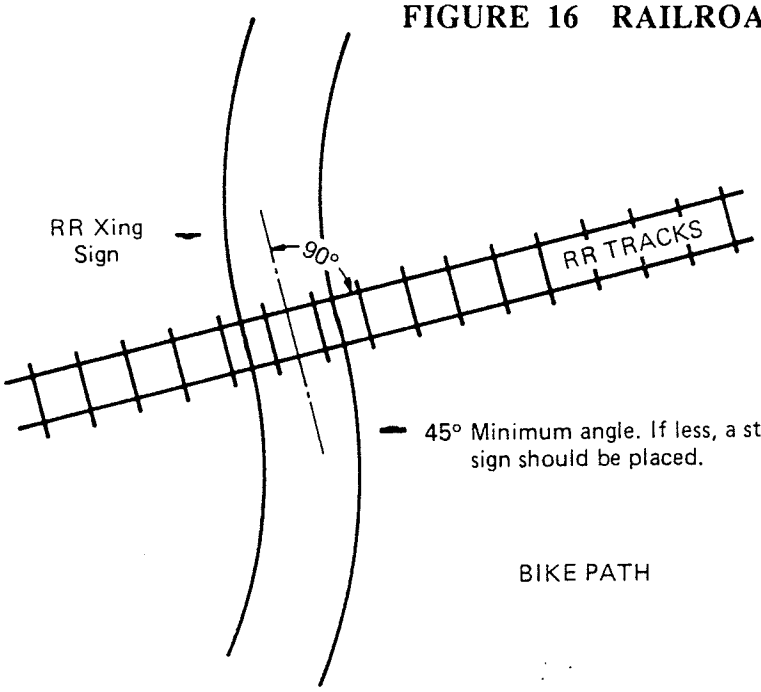
3.23 Pavement

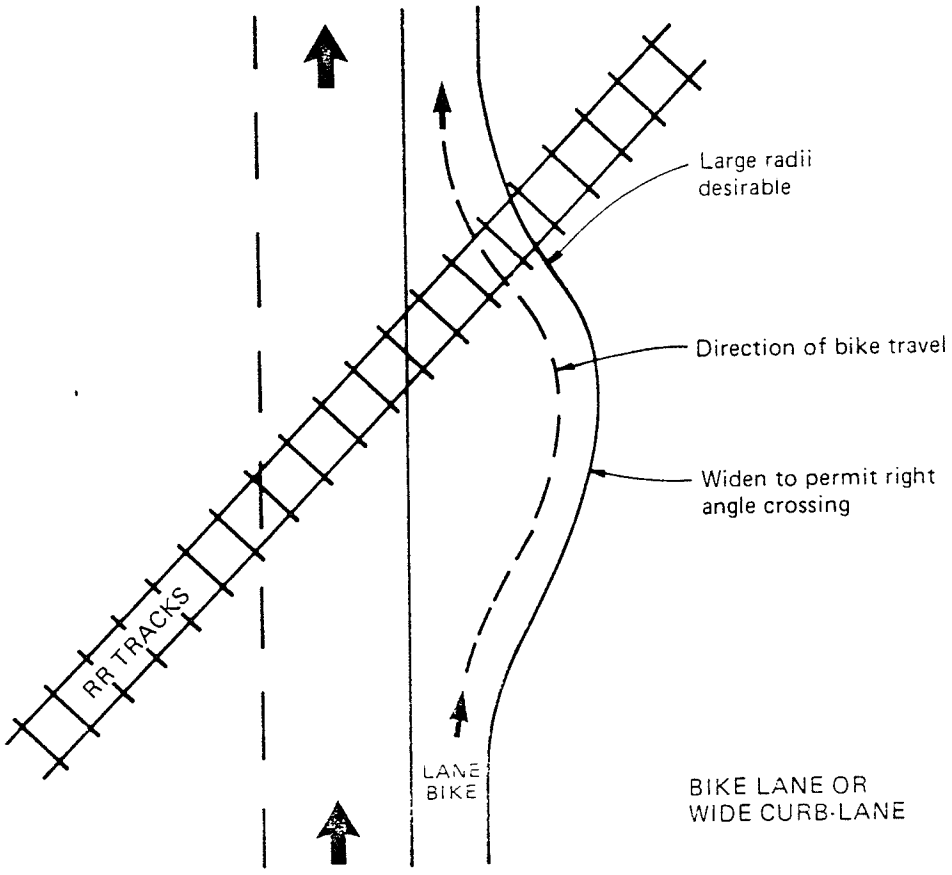
Pavement surface irregularities can do more than cause an unpleasant ride. Gaps between pavement slabs or drop-offs at overlays parallel to the direction of travel can trap a bicycle wheel and cause loss of control; holes and bumps can cause bicyclists to swerve into the path of motor vehicle traffic. Thus , to the extent practicable, pavement surfaces should be uniform in width with no drop-offs at the shoulder. On some pavements it may be necessary to fill joints, adjust utility covers or, in extreme cases, overlay the pavement to make it suitable for bicycling. Regular street sweepings are a must, as most often it is the outer edge of the pavement where bicyclists travel that debris, car parts, broken glass, loose asphalt, etc. collects, and can upset a passing cyclists.

3.24 Traffic Control Devices

At intersections where bicycle traffic exists or is anticipated, bicycles should be considered in the timing of the traffic signal cycle, as well as the traffic detection device. Normally a bicyclist can cross an intersection under the same signal phasing arrangement as

FIGURE 16 RAILROAD CROSSINGS





Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-4.

motor vehicles; however, on multi-lane streets special consideration should be given to ensure that short clearance intervals are not used. If necessary, an all *red* clearance interval may be used.

To check the clearance interval, a bicyclist's speed of 10 mph (16km/h) and a perception/reaction/braking time of 2.5 seconds, can be used. Detectors for traffic-actuated signals should be sensitive to bicycles and should be located in the bicyclist's expected path, including left turn lanes. Where programmed visibility signal heads are used, they should be checked to ensure that they are visible to bicyclists who are properly positioned on the road. Appropriate signs and pavement markings should be used where required. Where bicyclists are expected to use different routes than motorists, directional signing should be used to confirm to bicyclists that the special routing leads to their destination.

3.25 Shoulders

Wide curb lanes and bicycle lanes are usually preferred over shoulders for use by bicyclists. However, if it is intended that bicyclists ride on shoulders, smooth paved shoulders surfaces must be provided. Pavement edge lines supplement surface texture in delineating the shoulder from the motor vehicle lanes. Rumble strips can be a deterrent to bicycling on shoulders and their benefits should be weighed against the probability that the bicyclists will ride in the motor vehicle lanes to avoid them.

Shoulder width should be a minimum of 4 feet (1.2 m) when intended to accommodate bicycle travel. Roads with shoulders less than 4 feet wide normally should not be signed as bikeways. If motor vehicle speeds exceed 35 mph (55 km/h), if the percentage of trucks, buses and recreational vehicles is high, or if static obstructions exist at the right side, then additional width is necessary.

Adding or improving shoulders can often be the best way to accommodate bicyclists in rural areas, and they are also a benefit to motor vehicle traffic. Where funding is limited, adding or improving shoulders on uphill sections first, will give the slower moving bicyclists extra manoeuvering space and will decrease conflicts with faster moving motor vehicle traffic.

3.26 Wide Curb Lanes

On highway sections without bicycle lanes, a right lane wider then 12 feet (3.7 m) can better accommodate both bicyclists and motor vehicles in the same lane and thus is

beneficial to both bicyclists and motorists. In many cases where there is a wide curb lane, motorists will not need to change lanes to pass a bicyclist. Also, additional manoeuvering room is provided when drivers are exiting from driveways or in areas with limited sight distance. In general, a lane width of 14 feet (4.3 m) of usable pavement width is desired. Drainage grates, parking and longitudinal ridges between pavement and gutter sections are not considered usable pavement.

Widths greater than these can encourage the undesirable operation of two motor vehicles in one lane, especially in urban areas. When widths exceed 14 feet of usable pavement surface, a pavement edge line should be striped to discourage the operation of two motor vehicles in one lane. For example, if 15 feet of usable pavement surface exists, 11 feet could be striped for the motor vehicle lane, whereby, the minimum desirable 4 feet of remaining width adjacent to the motor vehicle lane would be provided for the cyclist. Figure 17-a shows a typical urban roadway with a wide curb lane. When a right-turn only lane exists at an intersection, the additional width should be placed in the right most through lane (See Figure 19).

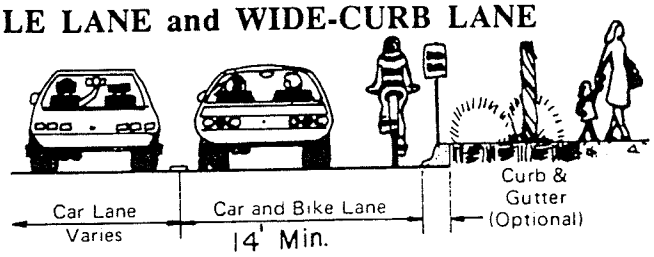
Restriping to provide wide curb lanes can be accomplished on most existing multi-lane facilities by making the remaining travel lanes and left-turn lanes narrower. This should be performed after careful review of traffic characteristics along the corridor.

3.3 BICYCLE ROUTES - CLASS III

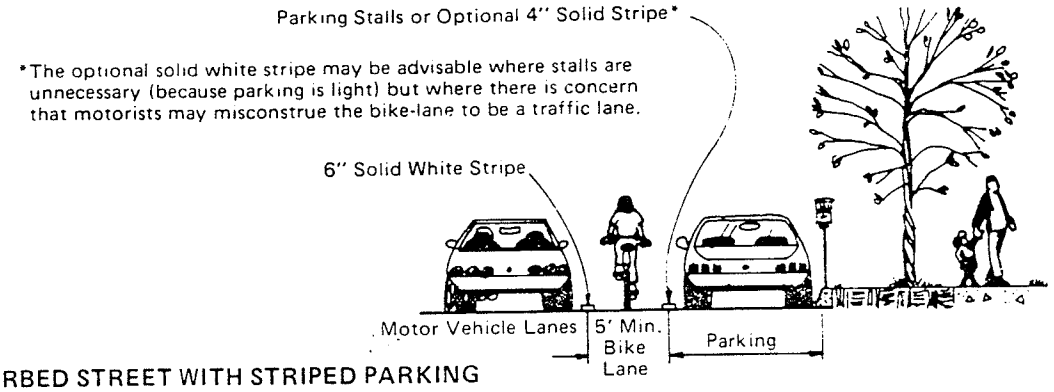
The type of facility to select in meeting the bicycle need is dependent on many factors. Presently most bicycle travel occurs on streets and highways without bikeway designation. This will undoubtedly be true in the future as well. In some instances, entire street systems may be fully adequate for safe and efficient bicycle travel thus signing and striping for bicycle use may not be warranted. In other cases, routes may be inherently unsafe for bicycle travel and it would be inappropriate to encourage additional bicycle travel by designating the routes as bikeways. Finally, routes may not be along high bicycle demand corridors and it would also be inappropriate to designate bikeways regardless of roadway conditions (e.g., on minor residential streets). The three classifications for bikeways are the routes, lanes and paths.

It may be advantageous to sign some urban and rural roadways as bicycle routes. When providing continuity to other bicycle facilities, a bicycle route can be relatively short.

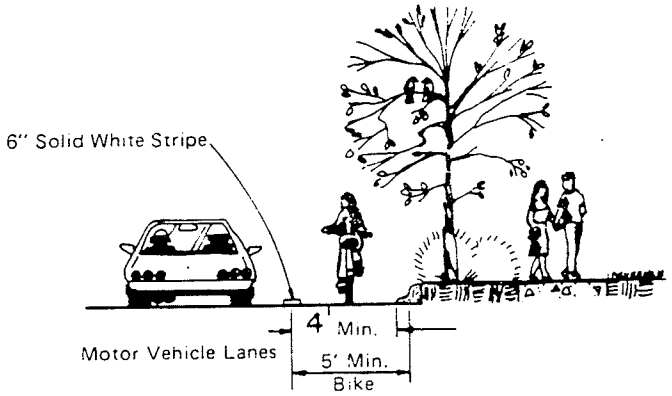
FIGURE 17 BICYCLE LANE and WIDE-CURB LANE



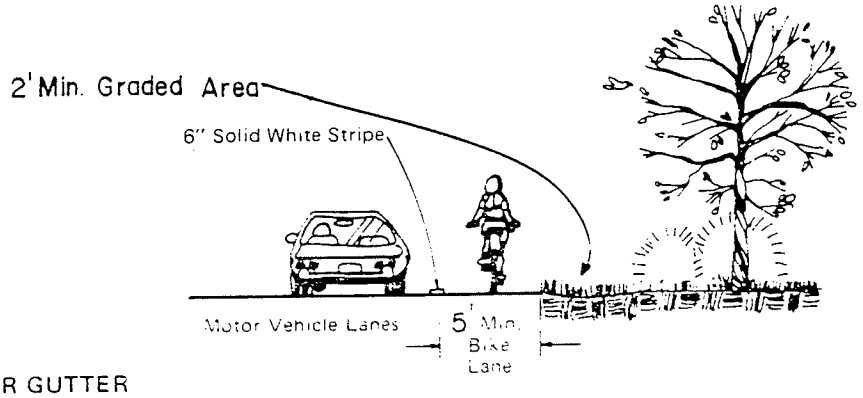
a. WIDE CURB-LANE



b. CURBED STREET WITH STRIPED PARKING



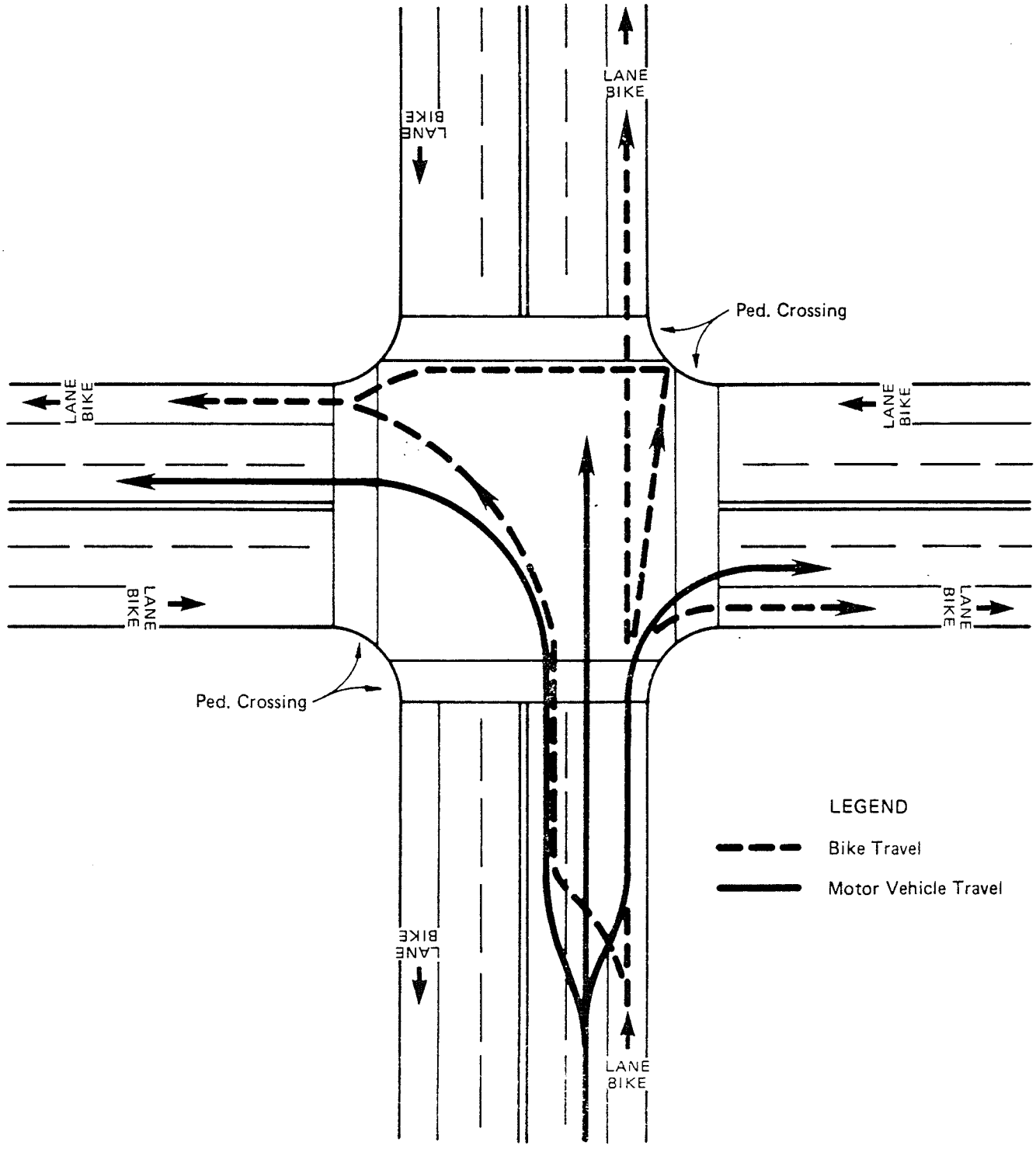
c. CURBED STREET WHERE PARKING IS PROHIBITED



d. STREET WITHOUT CURB OR GUTTER

Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-7.

FIGURE 18 BICYCLE/AUTO MOVEMENTS at INTERSECTIONS with MULTILANE STREETS



Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-12.

However, a bicycle touring route can become quite long. For longer bicycle routes, a standard bicycle route marker with a numerical designation can be used in place of a bicycle route sign. It is also recommended that supplemental plaques with bicycle route signs or markers be installed to furnish additional information, such as direction changes in the route, and intermediate range distance and destination information.

Overall, the decision whether to provide a bicycle route should be based on the advisability of encouraging bicycle use on a particular road, instead of on parallel and adjacent highways. The roadway width, along with factors such as the volume, speed, and type of traffic, parking conditions, grade, and sight distance should all be considered when determining the feasibility of a bicycle route. Generally, bicycle traffic cannot be diverted to a less direct alternate route unless the favourable factors outweigh the inconvenience to the bicyclists. As a rule, it is thought that an alternate but safer route would not be used if it forces the cyclist to travel an additional 10% longer distance than the original route. Roadway improvements, such as safe drainage grates, railroad crossings, smooth pavements, maintenance schedules, and signals responsive to bicycles, should always be considered before a roadway is identified as a bicycle route.

3.4 BICYCLE LANES - CLASS II

Bicycle lanes can be considered when it is desirable to delineate the right-of-way assigned to bicyclists and motorists and to provide for more predictable movements by each. Bicycle lanes may include striped lanes on the roadway, use of emergency parking lanes, or use of paved shoulders. Passing motorists are less likely to swerve into the bicycle lane, since the two would have separate lanes. Bicycle lane markings can increase bicyclists confidence in motorists not straying into their path of travel. Likewise, passing motorists are less likely to pull out to the left of their lane when they are overtaking a cyclist on their right. Raised pavement markings and raised barriers present a hazard to bicyclists and should not be used to delineate bicycle lanes. Also, thermoplastic pavement markings pose a hazard to bicyclists because they are very slippery, especially when wet. Paint is preferred to delineate bike lanes. Bike lanes should always be one-way facilities and flow in the same direction as adjacent motor vehicle traffic. Two-way bicycle lanes on one side of the roadway are undesirable because they promote riding against the flow of traffic which may lead to an increase in bicycle accidents.

3.41 Bicycle Lane Widths

Under ideal conditions, the minimum desirable bicycle lane width is 4 feet (1.2 m). However, certain edge conditions dictate additional bicycle lane width. To examine the width requirements for bicycle lanes, figure 17 shows four typical locations for such facilities in relation to the roadway. Figure 17-b depicts bicycle lanes on an urban curbed street where a parking lane is provided. The minimum bicycle lane width for this location is 5 feet (1.5m). Bicycle lanes should always be placed between the parking lane and the motor vehicle lanes. Bicycle lanes between the curb and the parking lane create hazards for bicyclists from opening doors and poor visibility at intersections and driveways, and they prohibit bicyclists from making left turns; therefore this placement should never be considered.

Where parking is permitted but a parking lane is not provided, the combination lane, intended for both motor vehicle parking and bicycle lane use, should be a minimum of 12 feet (3.7 m) wide. However, if it is likely the combination lane will be used as an additional motor vehicle lane, it is preferable to designate separate parking and bicycle lanes as shown in figure 17-b. In both instances, if parking volume is substantial and turnover is high, an additional 1 or 2 feet (0.3 or 0.6 m) of width is desirable for safe bicycle operation.

Figure 17-c depicts bicycle lanes along the outer portions of an urban curbed street where parking is prohibited. Bicyclists do not generally ride near a curb because of the possibility of debris, of hitting a pedal on the curb, of an uneven longitudinal joint, or of a steeper cross slope.

Bicycle lanes in this location shall have a minimum width of 5 feet (1.5 m) from the curb face. If the longitudinal joint between the gutter pan and the roadway surface is uneven and falls within 5 feet (1.5 m) of the curb face, a minimum of 4 feet (1.2 m) should be provided between the joint and the motor vehicle lanes. The City of Davis, California utilizes a gutter pan that is 5 feet wide. This serves to eliminate the longitudinal joint from the cyclist's path and it creates a different colour than the asphalt roadway, helping to further delineate the bike lane from the roadway.

Figure 17-d illustrates bicycle lanes on a highway without a curb or gutter. Bicycle lanes should be located between the motor vehicle lanes and the roadway shoulders. Bicycle lanes may have a minimum width of 4 feet, where the shoulder can provide

additional manoeuvering width if paved. A width of 5 feet or greater is preferable; additional widths are desirable where substantial truck traffic is present, where prevailing winds are a factor, or where motor vehicle speeds exceed 35 mph (55 km/h), or if the shoulder is not paved.

The typical width for a motor vehicle lane adjacent to bike lane is 12 feet (3.6 m). There are situations where it may be necessary to reduce the width of motor vehicle lanes in order to stripe bike lanes. In determining the appropriateness of narrower motor vehicle lanes, consideration should be given to factors such as motor vehicle speeds, truck volumes, road alignment, and sight distance. Where favourable conditions exist, motor vehicle lanes of 10 to 11 feet (3.0 to 3.3 m) may be feasible.

Bike lanes are not advisable on long steep downgrades, where bicycle speeds are greater than 35 mph (55 km/h) are expected. As grades increase, downhill bicycle speeds increase, thereby increasing the danger of riding near the edge of the roadway. In such situations, bicycle speeds can approach those of motor vehicles, and experienced bicyclists generally move into the motor vehicle lanes to increase sight distance and manoeuverability. If bike lanes are to be striped, additional width or a dashed line should be provided to accommodate the higher bicycle speeds.

3.42 Bicycle Lanes on One-Way Streets

If the bike lanes are to be located on one-way streets, the following guidelines should be kept in mind:

1 It is preferable to have lanes on both sides of the one-way street, thus accommodating all origin/destination needs and minimizing crossing manoeuvres. If not feasible, consider deleting bike lanes along such sections.
2 Bicycle lanes on the left side may be desirable as they will reduce conflicts that may occur with heavy bus traffic or frequent mid-block right turns into entranceways.

3.43 Intersections with Bicycle Lanes

Bicycle lanes tend to complicate both bicycle and motor vehicle turning movements at intersections. Because they encourage bicyclists to keep to the right and motorists to the left, both operators are somewhat discouraged from merging in advance of turns. Thus, some bicyclists will begin left turns from the right-side bicycle lane and some motorists will begin right turns from the left of the bicycle lane. Both manoeuvres are contrary to established *Rules of the Road* and result in conflicts. Common movements of motorists and bicyclists are shown on figure 18.

Safe movement of bicyclists through intersections is of paramount concern. A high percentage of bicycle-motor vehicle collisions take place at intersections. For this reason bikeway design at intersections should be accomplished in a manner that will minimize confusion by motorists and bicyclists, and will permit both to operate in accordance with the normal rules of the road. A number of elements compound the basic fact that intersections are inherently points of significant traffic conflict. Among these are human error, basic conflict between behaviour and expectations, and the fact that measures undertaken to improve motor vehicle flows and safety may conflict with bicyclist operational convenience and safety. There is no single measure that will provide a primary solution to the intersection problem. Each intersection must be studied individually. At intersections, bicyclists proceeding through and motorists turning right must cross paths. Striping and signing configurations which encourage these crossings in advance of the intersection, in a merging fashion, are generally preferable to those that force the crossing in the immediate vicinity of the intersection. To a lesser extent, the same is true for left turning bicyclists; however, in this manoeuvre, the bicyclist has the option of making either a "vehicle style" left turn (where the bicyclist merges leftward to the same lane used for motor vehicle left turns) or a "pedestrian style" left turn (where the bicyclist proceeds straight through the intersection, turns left at the far side, then proceeds across the intersection on the cross street).

When confronted with such intersections, bicyclists have to merge with right-turning motorists. Since bicyclists are typically travelling at lower speeds than motorists, they should signal and merge where there is a sufficient gap in right-turning traffic, rather than at any predetermined location. For this reason, it is recommended that either all delineation be dropped at the approach of the right-turn lane (or off-ramps) or that a single, dashed bike lane line be used to aid the smooth transition across the right-turn lane (See Figure 19). A pair of parallel lines (delineating a bike lane crossing) to channel the bike merge is not recommended, as this will encourage bicyclists to cross at a predetermined location, rather than when there is a safe gap in right-turning traffic. Also, some bicyclists are more apt to assume that they have the right of way, and may not check for right-turning motor vehicle traffic.

A dashed line across the right-turn-only lane (or off-ramp) is not recommended on extremely long lanes, or where there are double right-turn-only lanes. For these types of intersections, all striping should be discontinued to allow the bicyclists' judgment to

prevail. Bike lanes crossing on-ramps do not present the same problem, as bicyclists normally have a good view of traffic entering the roadway, and will adjust their path as necessary to cross ramp traffic. A "Bike Xing" sign may be used to warn motorists of the potential for bicyclists crossing their path.

Figure 20 presents examples of details on pavement markings for bicycle lanes approaching motorists right turn only lanes and for on and off ramps. Where there are numerous left-turning bicyclists, a separate turning lane should also include appropriate signing at intersections to reduce the number of conflicts.

3.44 Signal Design for Bicycle Lanes

At intersections where there are bike lanes and traffic signals, the installation of bicycle-sensitive loop detectors within the bike lane is desirable. This is particularly important where signals are traffic-actuated, and will not change for a bicyclist unless a motor vehicle is present, or unless the bicyclist leaves the bike lane to trip the signal within the traffic lane. Generally, push button actuators are unsatisfactory at intersections; if the actuator is not properly located near the curb, bicyclists may have to dismount to reach it on the sidewalk. Often button activators are located 4 feet from the face of the curb. It is also important that loop detectors on left-turn lanes be sensitive enough to detect bicycles. Where significant bicycle use is anticipated on any street with traffic-actuated signals, it is recommended that loop detectors are installed that are sensitive enough to detect bicycle.

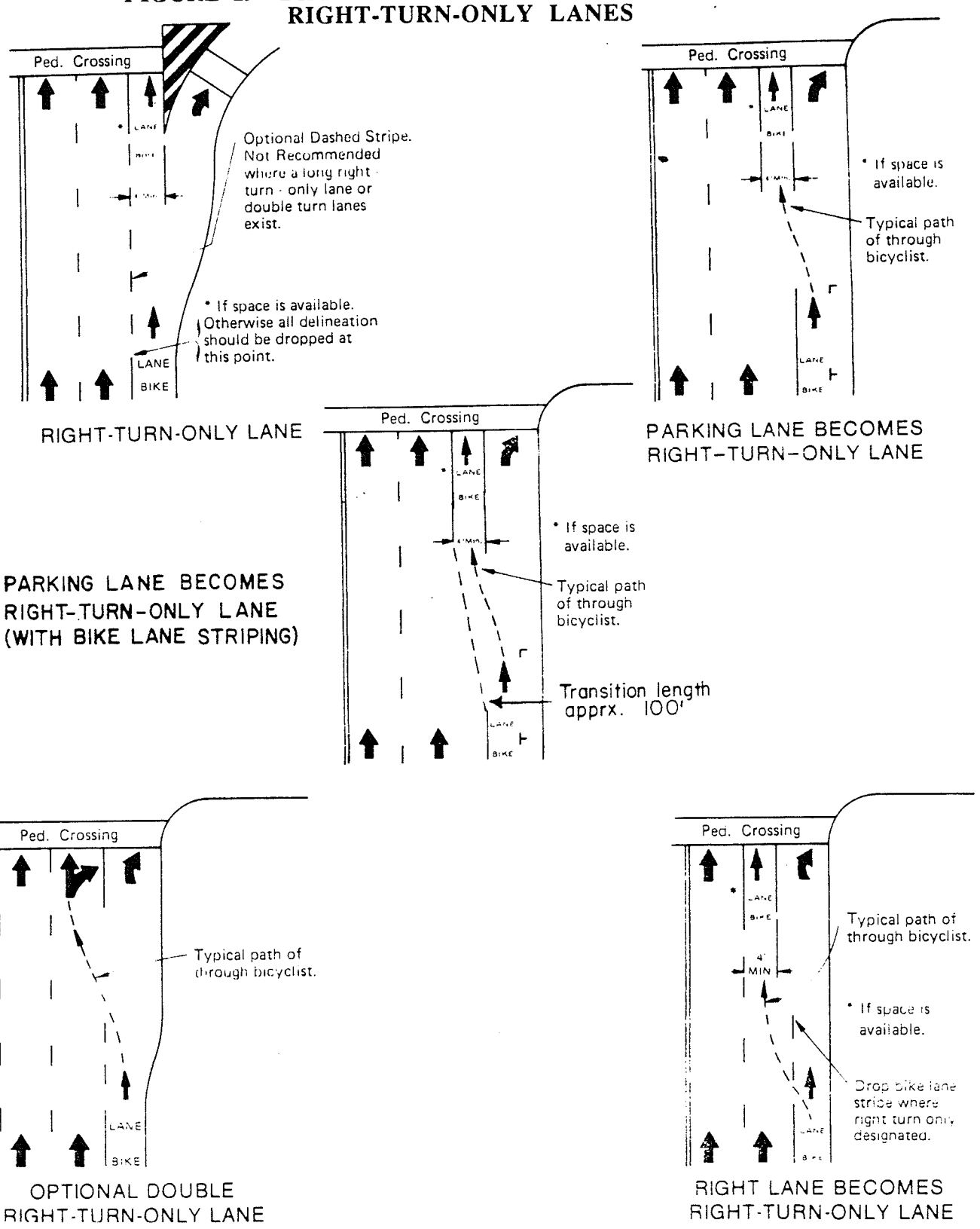
3.45 Striping and Signing Bicycle Lanes

Raised barriers (e.g., raised traffic bars and asphalt concrete dikes) or raised pavement markers must not be used to delineate bike lanes. Raised barriers and pavement markers prevent motorists from merging into bike lanes when necessary, and restrict the movement of bicyclists desiring to enter or exit bike lanes. In addition, they can impede routine maintenance activities. Adequate pavement surface, bicycle-safe grate inlets, and safe railroad crossings should always be provided on roadways where bicycle lanes are being designated.

3.5 BICYCLE PATHS - CLASS I

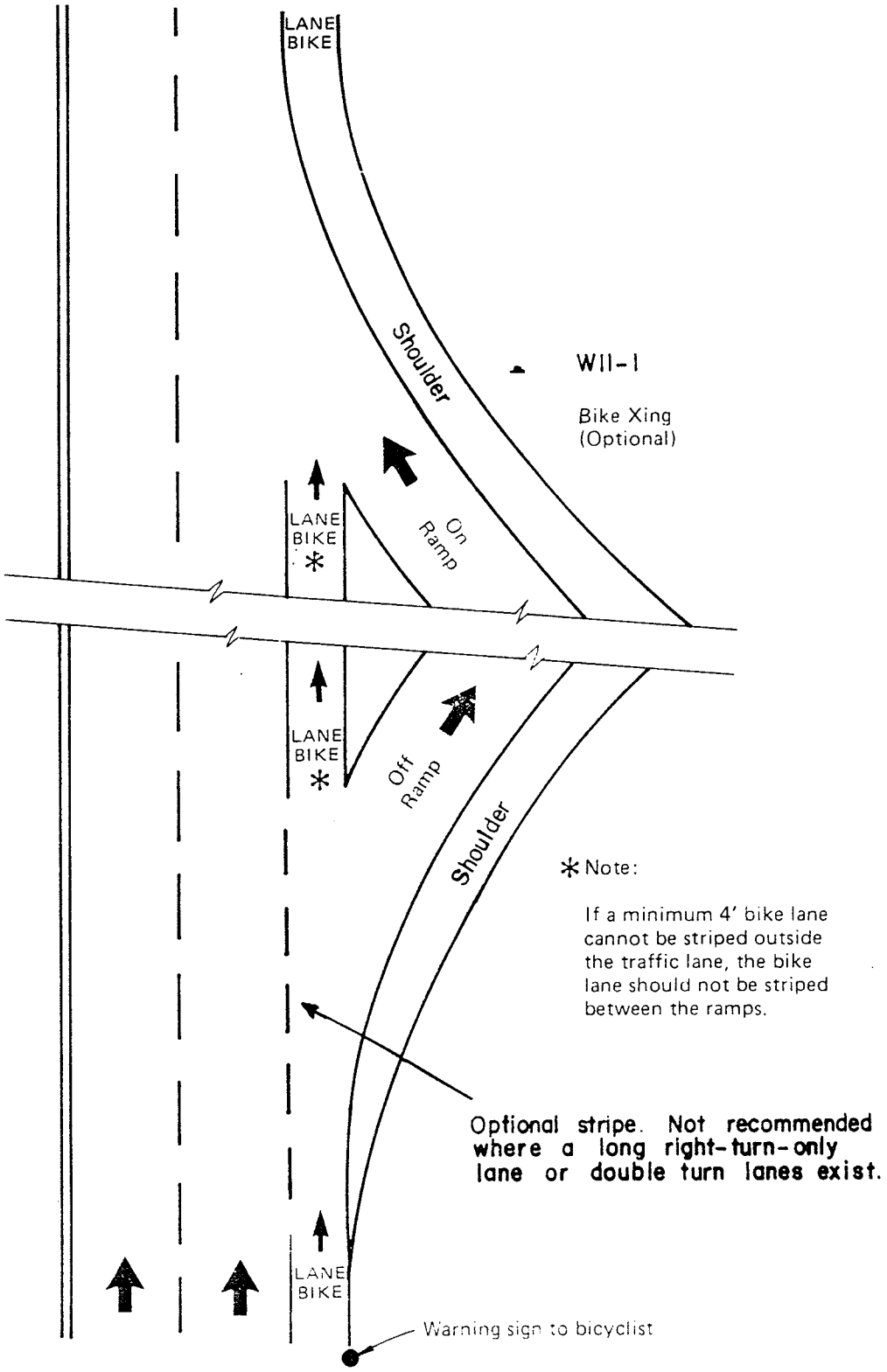
Bicycle paths are facilities on exclusive right-of-ways and with minimal cross flow by motor vehicles. Bicycle paths can serve a variety of purposes. They can provide a commuting bicyclist with a shortcut through a residential neighbourhood (e.g., a

FIGURE 19 BIKE LANES APPROACHING MOTORISTS RIGHT-TURN-ONLY LANES



Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-8.

FIGURE 20 BIKE LANE RAMP CROSSINGS



Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-14.

connection between two cul-de-sac streets). Located in a park they offer an enjoyable recreational opportunity with numerous vistas and views. Bicycle paths can be located along abandoned railroad right-of-ways, riverbanks, transmission lines, and other similar areas. Bicycle paths can also provide bicycle access to areas that are otherwise served only by limited access highways closed to bicycles. Appropriate locations can be identified during the planning process.

Bicycle paths should be thought of as extensions of the highway system that are intended for the exclusive or preferential use of bicycles in much the same way as freeways are intended for the exclusive or preferential use of motor vehicles. There are many similarities between design criteria for bicycle paths and those for highways (e.g., in determining horizontal alignment, sight distance requirements, signage and markings). (Although it is recommended that bike paths should not be placed immediately adjacent to streets and highways as experience has shown that the pathway may not be successful). On the other hand, some criteria (e.g., horizontal and vertical clearance requirements, grades, and pavement structure) are dictated by operating characteristics of bicycles that are substantially different from those of motor vehicles. The designer should always be conscious of the similarities and the differences between bicycles and motor vehicles and of how these similarities and differences influence the design of bicycle paths.

3.51 Width and Clearance

The paved width and the operating width required for a bicycle path are primary design considerations. Figure 21 depicts a bicycle path on a separated right-of-way. Under most conditions, a desirable minimum all paved width for a two directional bicycle path is 10 feet (3 m). In some instances, however, a minimum of 8 feet (2.4 m) can be adequate. Although this minimum should only be considered where the following conditions prevail:

1 Bicycle travel is expected to be low, even on peak days or during peak hours;

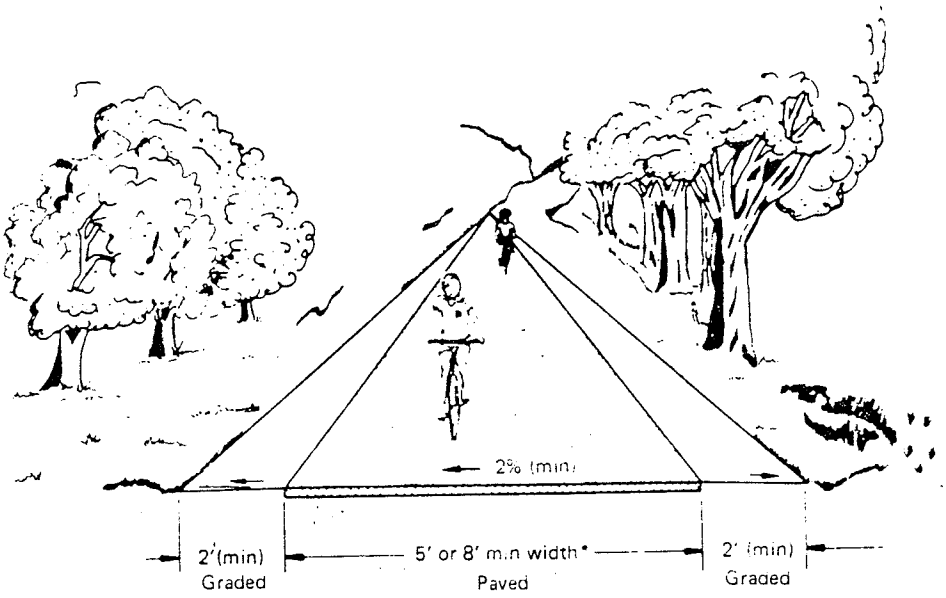
2 Pedestrian use of the facility is not expected to be more than occasional;

3 There will be good horizontal and vertical alignment providing safe and frequent passing opportunities; and,

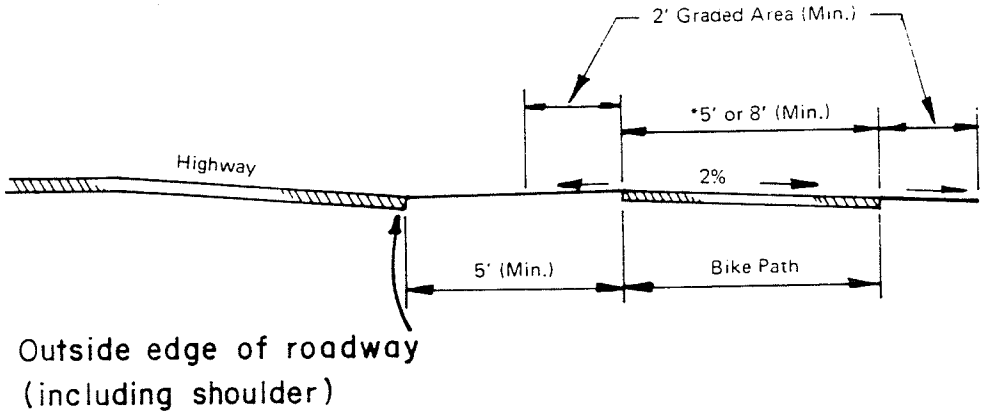
4 The path will not be subjected to maintenance vehicle loading conditions that would cause pavement edge damage.

Under certain conditions it may be necessary or desirable to increase the width of a bicycle path to 12 feet (3.7 m), this would be done when; a substantial bicycle volume is expected,

FIGURE 21 TWO-WAY BIKE PATH on SEPARATED RIGHT-OF-WAY



*One–Way: 5' Minimum Width
Two–Way: 8' Minimum Width
Metric Conversion: 1 ft. = 0.3m.
(Not to Scale)



*One-way: 5' Minimum Width
Two-Way: 8' Minimum Width

Source: State of Florida Department of Transportation,
Bicycle Facilities Planning and Design Manual, p.5-19.

probable shared use with joggers and other pedestrians, occasional traffic from large maintenance vehicles, steep grades and where bicyclists will be likely to ride two abreast.

The minimum width of a one-directional bicycle path is 5 feet (1.5 m). It should be recognized, however, that one-way bicycle paths will often be used as two-way facilities unless effective measures are taken to ensure one-way operation. Without such enforcement, it should be assumed that bicycle paths will be used as two-way facilities and designed accordingly.

A minimum 2 foot (0.6 m) width graded area should be maintained adjacent to both sides of the pavement; however, 3 feet (0.9 m) or more is desirable to provide clearance from trees, poles, walls, fences, guardrails, or their lateral obstructions. A wider graded area on either side of the bicycle path can serve as a separate jogging path. A wide separation between a bicycle path and canals, ditches or other significant depressions is essential for safety. A minimum 7 foot separation from the edge of the bike path pavement to the top of the slope is required. If this is not possible, a positive barrier such as dense shrubbery or a chain link fence should be provided. This should be a graded area with no greater than a 5% slope.

Similarly, a wide separation between a bicycle path and an adjacent highway is desirable to confirm to both the bicyclist and the motorist that the bicycle path functions as an independent highway for bicycles. When this is not possible and the distance between the edge of the roadway and the bicycle path is less than 5 feet (1.5 m), a suitable physical divider, such as a fence, dense shrubs or other barrier, should be included in the design. Such dividers serve both to prevent bicyclists from making unwanted movements between the path and the highway shoulder and to reinforce the concept that the bicycle path is an independent facility. Where used, the divider should be a minimum of 4.5 feet (1.4 m) high, to prevent bicyclists from toppling over it, and it should be designed so that it does not become a hazard in itself.

The vertical clearance to obstructions should be a minimum of 8 feet (2.4 m). However, vertical clearance may need to be greater to permit passage of maintenance vehicles and, in undercrossings and tunnels, a clearance of 10 feet (3 m) is desirable for adequate vertical distance.

Table 20 Typical Bicycle and Rider Dimensions

Characteristics	Dimension (feet)
Width	2.00
Length	5.75
Height	8.00
Vertical Pedal Clearance	0.50

Source: Minneapolis Department of Transportation, *Minneapolis Design Manual*, p.20.

3.52 Design Speed

The speed that a bicyclist propels himself at is a function of several factors, including the type and condition of the bicycle, the purpose of the trip, the condition and location of the path, the speed and direction of the wind, and the physical condition of the bicyclist. Bicycle paths should be designed for a selected speed that is at least as high as the preferred speed of the faster bicyclists. In general, a minimum design speed of 20 mph (32 km/h) should be incorporated, however, when the grade exceeds 4 percent. Or where strong prevailing tailwinds exist, a design speed of 30 mph (48 km/h) is advisable. On unpaved roads, where bicyclists tend to ride slower, a lower design speed of 15 mph (24 km/h) can be employed. Similarly, where the grades of the prevailing winds dictate, a higher design speed of 25 mph (40 km/h) can be implemented. Since bicycles have a greater proclivity to skid on unpaved surfaces, horizontal curvature design should take into account these lower coefficients of friction. Finally, 'speed bumps', or similar surface obstructions, intended to slow down bicyclists in advance of intersections, should not be used.

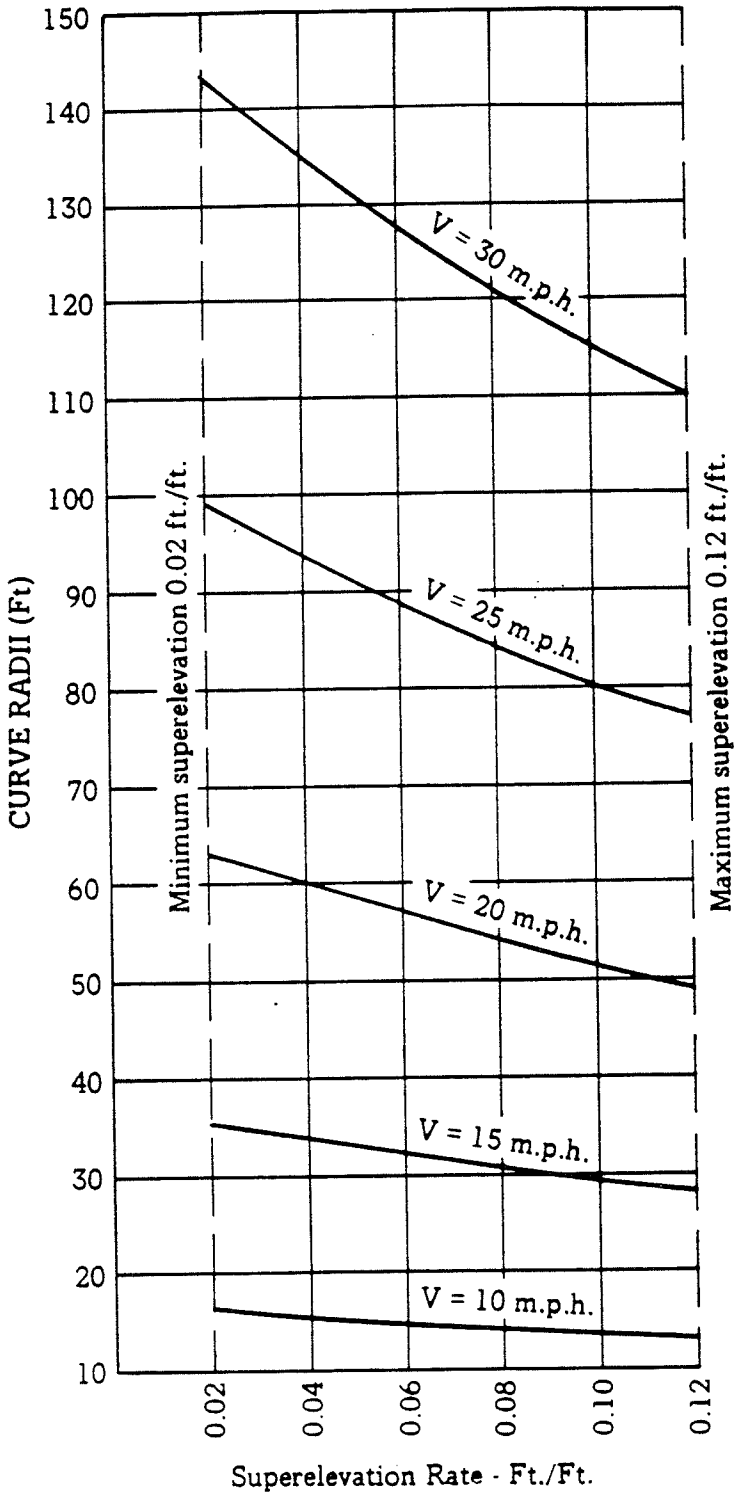
3.53 Horizontal Alignment and Superelevation

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

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

Where R = Minimum Radius of Curvature (feet)
V = Design Speed (mph)
e = Rate of Superelevation
f = Coefficient of Friction

FIGURE 22 CURVE RADII and SUPERELEVATIONS



plot of: $\frac{V^2}{gR} = \frac{\tan\theta + f}{1 - f\tan\theta}$

Where: V = velocity, ft./sec.
g = acceleration due to gravity, ft./sec.^{2}
R = radius of curvature, ft.
f = coefficient of friction on dry pavement = 0.4 (based on maximum 20° lean)
$\tan\theta$ = superelevation rate, ft./ft.

Source: Minneapolis Department of Transportation, *Minneapolis Design Manual*, p.16.

For most bicycle path applications, the superelevation rate will vary from a minimum of 2 percent (the minimum necessary to maintain adequate drainage) to a maximum of approximately 5 percent (beyond which manoeuvering difficulties by slow bicyclists might be expected). The minimum superelevation rate of 2 percent will be adequate for most conditions and will simplify construction.

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

Based upon a superelevation rate (e) of 2 percent, the minimum radii of curvature can be selected from Table 21.

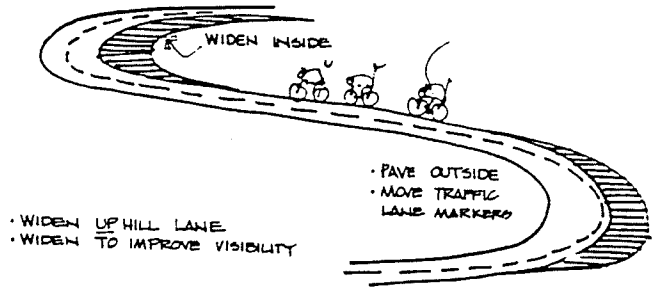
Table 21 Design Radii for Paved Bicycle Paths

V	f	R	e = 2%
Design Speed (mph)	Friction Factor	Design Radius	
(1mph = 1/6 km/h)		(1 foot = 0.3 m)	
20	0.27	95	
25	0.25	155	
30	0.22	250	
35	0.19	390	
40	0.17	565	

Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-22.

When substandard radius curves must be used on bicycle paths because of right-of-ways, topographical or other considerations, standard curve warning signs and supplemental pavement markings should be installed. The negative effects of substandard curves can also be partially offset by widening the pavement through the curves. (See Figure 23).

FIGURE 23 PATH WIDTH



Source:Unknown

3.54 Grades

The grade which a bicycle can be expected to negotiate is dependent upon the length of the grade, characteristics of the bicyclist (age, weight, condition, etc.), characteristics of the bicycle (type of cycle, gear ratios, weight, tires, etc.), wind velocity, air resistance and road surface. As all of these determinants are variable, it is not possible to specify definite design grades. Generally speaking, the amount of energy required to use a bicycle route will affect the usage of the route and, thus, grades should be kept to a minimum.

Desirably, a grade of 5% should not be longer than 100 feet and a grade of 2% should not be longer than 500 feet. Grades of 5% for over 300 feet and 2% for over 1 500 feet should ultimately be avoided. Steep grades are undesirable because the ascents are difficult for many bicyclists to climb and the descents cause some bicyclists to exceed the speeds at which they are competent to negotiate. Grades should be minimized even at the expense of having to provide added curvature or travel distance within the practical limits for the site.

3.55 Sight Distance

To provide bicyclists with an opportunity to see and react to the unexpected, a bicycle path should be designed with adequate stopping sight distances. The distance required to bring a bicycle to a full controlled stop is a function of the bicyclist's perception and brake reaction time, the initial speed of the bicycle, the coefficient of friction between the tires and the pavement, and the braking ability of the bicycle. Figure 24 and Table 22 illustrate the minimum stopping sight distance for various design speeds and grades based on a total perception and brake reaction time of 2.5 seconds and a coefficient of friction of

0.25 to account for the poor wet weather braking characteristics of many bicycles. For two-way bicycle paths, the sight distance in the descending direction, that is, where "G" is negative, will control the design.

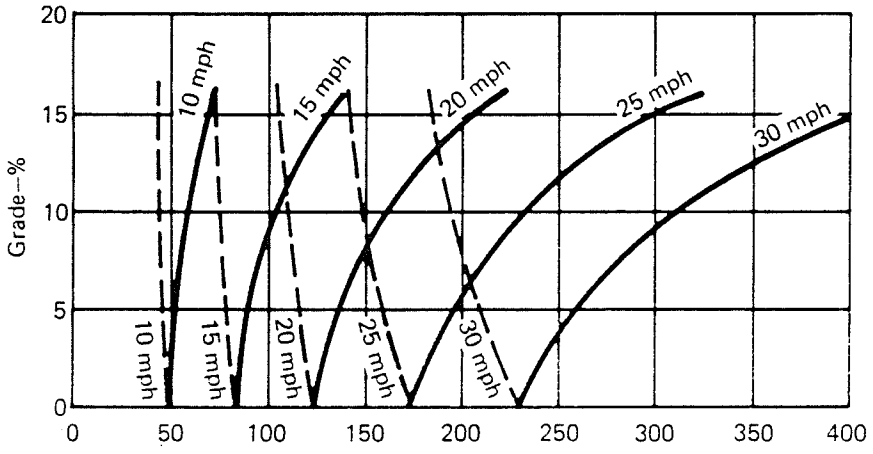
Table 22 Stopping Sight Distance for Downhill Grades

DESIGN	GRADE (%)			
SPEED	0%	5%	10%	15%
MPH	feet	feet	feet	feet
10	50	50	60	70
15	85	90	100	130
20	130	140	160	200
25	175	200	230	300
30	230	260	310	400

Source:Unknown

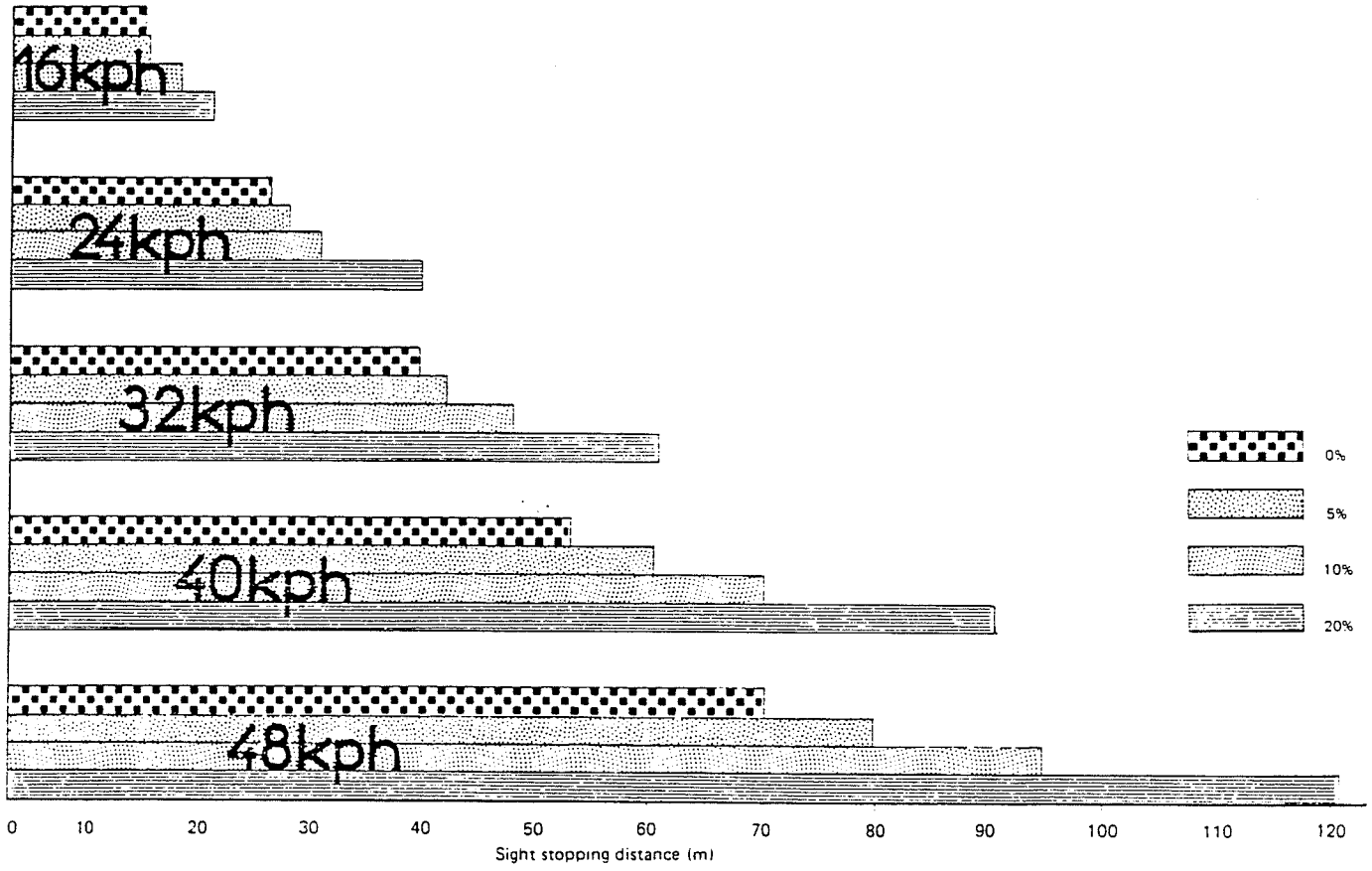
Figure 24 is used to select the minimum length of vertical curve necessary to provide stopping sight distance at various speeds on crests. The eye height of the bicyclist is assumed to be 4.5 feet (1.4 m) and the object height is assumed to be zero to recognize that hazards to bicycle travel exist at pavement level. Figure 25 indicates the distance required to stop as a function of travelling speed and path gradient.

FIGURE 24 SIGHT STOPPING DISTANCES



Source: State of Florida Department of Transportation,
Bicycle Facilities Planning and Design Manual, p.5-23.

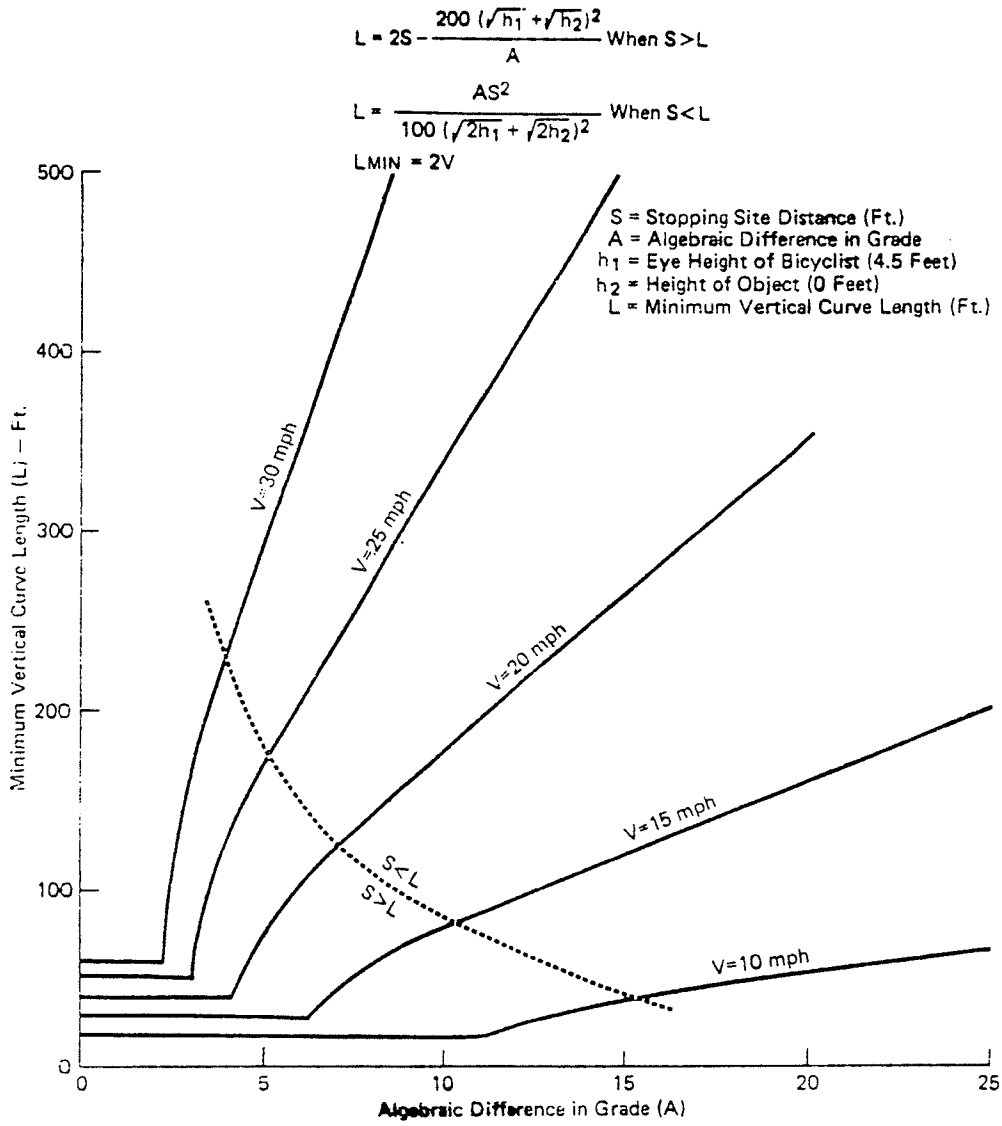
FIGURE 25 MAXIMUM SIGHT STOPPING DISTANCES for various DOWNHILL GRADIENTS



Source: *Design and Construction for Bikeway Construction Projects*, 1980.

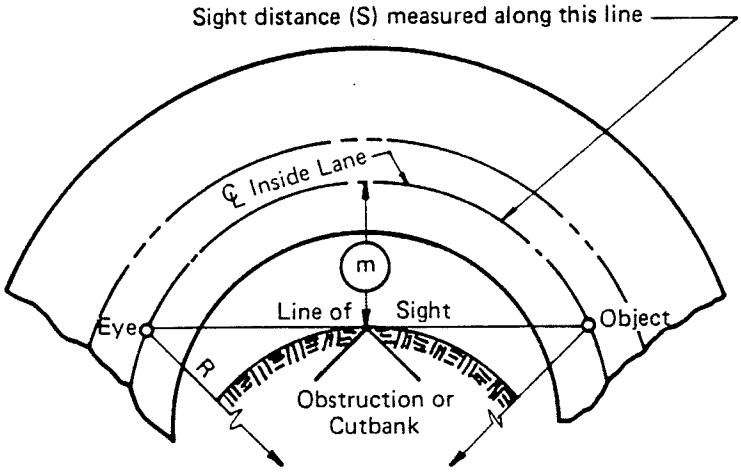
Figure 27 indicates the minimum clearance that should be used to line-of-sight obstructions for horizontal curves. The desired lateral clearance is obtained by entering Figure 27 (lateral clearance) with the stopping sight distance from Figure 24 (stopping sight distance) and the proposed horizontal radius of curvature.

FIGURE 26 SIGHT DISTANCES for CREST VERTICAL CURVES



Source: State of Florida Department of Transportation,
Bicycle Facilities Planning and Design Manual, p.5-24.

FIGURE 27 LATERAL CLEARANCES on HORIZONTAL CURVES.



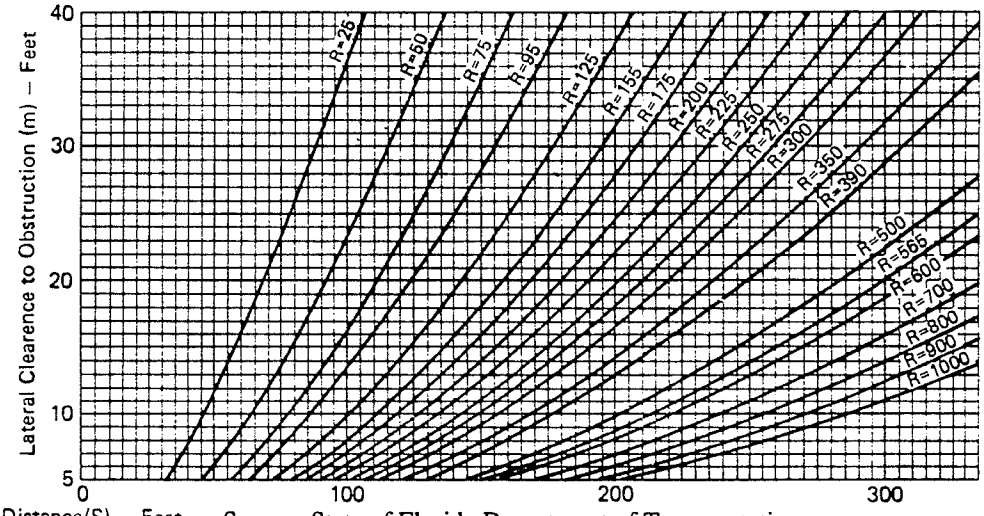
S = Sight distance in feet
R = Radium of ℄ inside lane in feet
M = Distance from ℄ inside lane in feet
V = Design speed for S in mph

Angle is expressed in degrees

$$m = R\left[\text{vers}\left(\frac{28.65S}{R}\right)\right]$$

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

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



Sight Distance(S) – Feet
(Metric conversion: 1 ft. = 0.3m.)

Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-25.

Bicyclists frequently ride abreast of each other on bicycle paths and, on narrow bicycle paths, bicyclists have a tendency to ride near the middle of the path. For these reasons, and because of the serious consequences of a head-on bicycle accident, lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists travelling in opposite directions around the curve. Where this is not possible or feasible, consideration should be given to widening the path through the curve, installing a yellow centre stripe, erecting a curve ahead warning sign, or some combination of these alternatives. On sharp curves, less than 100 foot radius, additional width may be needed due to bicycle lean, Table 23.

Table 23 Path Widths

Radius	Additional Paved Widths
feet	feet
0 - 25	4
25 - 50	3
50 - 75	2
75 - 100	1
100 +	0

3.56 Intersections with Bicycle Paths

Intersections are an important consideration in bicycle path design. If alternate locations for a bike path are available, the one with the most favourable intersection conditions should be selected. The ideal intersection design is a grade separation, but in many cases its cost is prohibitive.

When intersections occur at grade, a major consideration is the establishment of right-of-ways. The type of traffic control to be used (signal, stop or yield sign, etc.) and location would be determined by an evaluative study of the site. Care should be taken to ensure that bike path signs are located so that motorists are not confused by them, and that roadway signs are placed so that cyclists are not confused by them. At crossings with infrequent automobile traffic such as residential or commercial driveways, bicycles should be given priority. In any event adequate sight distance and proper signing must be provided.

It is preferable that the crossing of a bicycle path and a highway be at a location away from the influence of intersections with other highways. Controlling vehicle movements at such intersections is more easily and safely accomplished through the application of standard traffic control devices and normal *Rules of the Road.* Where physical constraints prohibit such independent intersections, the crossings may be at or adjacent to the pedestrian crossing, rights-of-ways should be assigned and sight distance should be provided so as to minimize the potential for conflict resulting from unconventional turning movements. At crossings of high-volume, multi-lane arterial highways where signals are not warranted, consideration should be given to providing a median refuge area for crossing bicyclists.

Bicycle path intersections and approaches should be on flat grades, to allow for starting and stopping and adequate line-of-sight requirements. Stopping sight distances at intersections must be checked and adequate warning be provided to permit bicyclists to stop before reaching the intersection, especially on down grades. The maximum grade of the approaches should be 5 percent. Consideration should be given to a flat approach preceded by a short, steep, vertical section, in areas where slopes are unavailable.

Curb cuts at intersections should be the same width as the bicycle paths. Curb cuts and ramps should provide a smooth transition between the bicycle path and the roadway.

3.57 Signing and Marking

Adequate signing and marking are essential on bicycle paths, especially to alert bicyclists to potential hazards and to convey regulatory messages to both bicyclists and motorists at highway intersections. In addition, guide signing, indicating directions, destinations, distances, route numbers, and the names of crossing streets, should be used in the same manner as they are used on highways. In general, uniform application of traffic control devices will tend to encourage proper bicyclist behaviour.

The path may include a 4 inch (10 cm) wide yellow centreline stripe to separate opposite directions of travel. This is particularly beneficial in the following circumstances:

- For heavy volumes of bicycles;
- On curves with restricted sight distance; and,
- On unlit paths where night-time riding is expected.

Edge lines can also be very beneficial where night-time bicycle traffic is expected.

Care should be exercised in the choice of pavement marking materials. Some marking materials, for example, become slippery when wet and should be avoided in favour of more skid resistant materials. Paint provides for the best results.

3.58 Pavement Structure

Designing and selecting pavement sections for bicycle paths is in many ways similar to designing and selecting highway pavement sections. A soils investigation should be conducted to determine the load carrying capabilities of the native soil and the need for any special provisions. The investigation need not be elaborate, but it is imperative, and should be done by, or under the supervision of a qualified engineer. In addition, there are several basic principles that should be followed to recognize some basic differences

between the operating characteristics of bicycles and those of motor vehicles. While loads on bicycle paths will be substantially less than highway loads, paths should be designed to sustain without damage, wheel loads of the occasional emergency, patrol, maintenance, and other motor vehicles that are expected to use or cross the path.

Special consideration should be given to the location of motor vehicle loads on the path. When motor vehicles are driven on bicycle paths, their wheels will usually be at or very near the edges of the path. Since this can cause edge damage that, in turn, will result in the lowering of the effective operating width of the path, adequate edge support should be provided. Edge support can either be in the form of stabilized shoulders or by constructing additional pavement width. Constructing a typical pavement width of twelve feet, where right-of-way and other conditions permit, eliminates the edge raveling problem and offers two other additional advantages over shoulder construction. First, it allows additional manoeuvering space for bicyclists and second, the additional construction cost can be less than for constructing shoulders because the separate construction operation is eliminated.

It is important to construct and maintain a smooth riding surface on bicycle paths. Bicycle path pavements should be machine laid; soil sterilants must be used where necessary to prevent vegetation from erupting through the pavement; transverse joints, necessary to control cracking, should be saw cut to provide a smooth ride. On the other hand, however, skid resistance qualities should not be sacrificed for the sake of smoothness. A broom finish concrete surface is preferred over trowel finishes, for example.

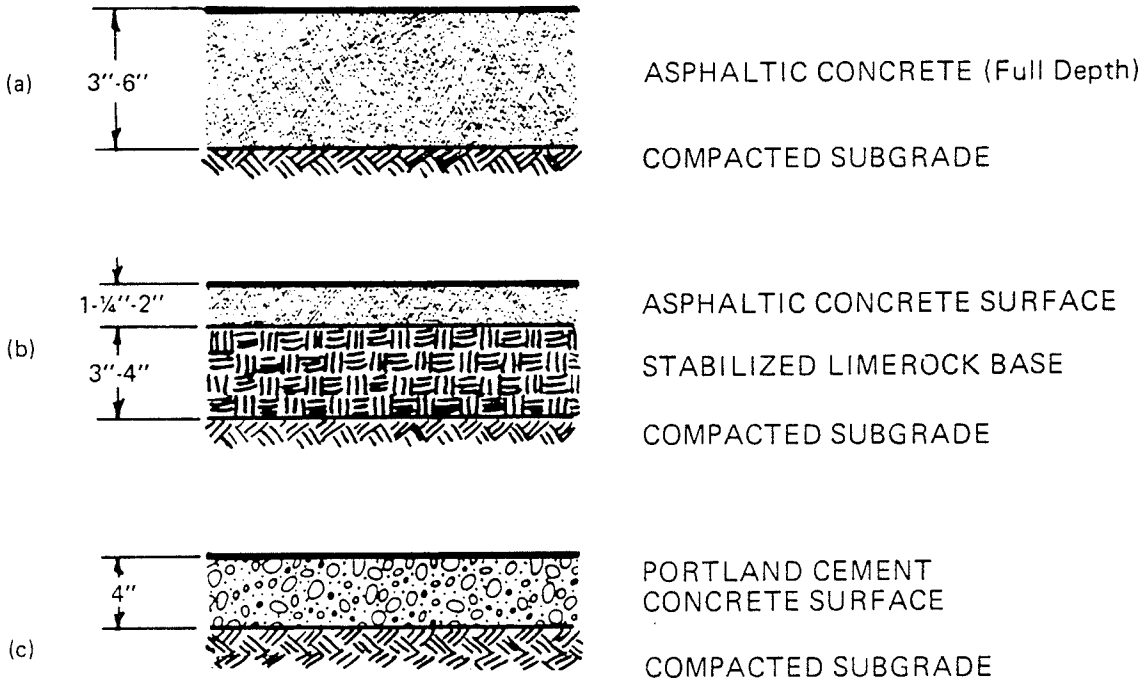
At unpaved highway or driveway crossings of bicycle paths, the highway or driveway should be paved a minimum of 10 feet on either side of the crossing to reduce the amount of gravel being scattered along the path by motor vehicles. The pavement structure at the crossing should be adequate to sustain the expected loading at that location. Hard, all weather pavement surfaces are usually preferred over those of crushed aggregate, sand, clay, or stabilized earth since these materials provide a much lower level of service.

Good quality pavement structures can be constructed of asphaltic or portland cement concrete. Because of wide variations in soils, loads, materials and construction practices, it is not practical to present specific or recommended typical structural sections that will be applicable province-wide. Attention to the local governing conditions and to the

principles outlined above is needed. Experience in highway pavement, together with sound engineering judgment, can assist in the selection and design of a proper bicycle path pavement structure and may identify energy saving practices, such as the use of sulfur-extended asphalt, asphalt emulsions, and fused wastes.

There are several combinations of the above mentioned materials possible in designing the full structural section. Figure 28 illustrates three possible examples. Example a) uses a full-depth, hot-mix asphalt pavement laid directly on the subgrade. Example b) uses a crushed limestone base with an overlying layer of asphalt. This pavement structure is usually preferable to the full-depth, hot-mix type, because it is more economical. Example c) depicts the use of portland cement concrete for bicycle paths. A structural section of the type normally used for pedestrian walks is adequate for bicycle travel, but a heavier section is necessary where vehicles are expected to use or cross the path.

FIGURE 28 TYPICAL PAVEMENT STRUCTURAL SECTIONS for BIKE PATHS



Source: State of Florida Department of Transportation, *Bicycle Facilities Planning and Design Manual*, p.5-31.

3.59 Structures

An overpass, small bridge or facility on a highway bridge may be necessary to provide continuity to a bicycle path. On new structures, the minimum clear width should be the same as the approach paved bicycle path; and the desirable clear width should

include the minimum 2-foot (0.6 m) wide clear areas. Carrying the clear areas across the structure has two advantages; first, it provides a minimum horizontal distance from the railing or barrier, and, second, it provides needed manoeuvering space to avoid conflicts with pedestrians and other bicyclists who are stopped on the bridge. Access by emergency, patrol, and maintenance vehicles should be considered in establishing the design clearance of structures on bicycle paths. Similarly, vertical clearance also may be dictated by motor vehicles occasionally using the path. However, where practical, a vertical clearance of 10 feet (3 m) is desirable for adequate vertical distance.

Railings, fences, or barriers on both sides of a bicycle path bridge should be a minimum of 4.5 feet (1.4 m) high. Smooth rub rails should be attached to the barriers at a handlebar height of 3.5 feet (1.1 m). Bridges designed exclusively for bicycle travel traffic may be designed for pedestrian live loadings. On all bridge decks, special care should be taken to ensure that bicycle-safe expansion joints are used. Where it is necessary to retrofit a bicycle path onto an existing highway bridge, several alternatives should be considered in light of what the geometrics of the bridge will allow.

One option is to carry the bicycle path across the bridge on one side. This should be done where:

1. The bridge facility will connect to a bicycle path at both ends;
2. Sufficient width exists on the side of the bridge or can be obtained by widening or restriping lanes; and,
3. Provisions are made to physically separate bicycle traffic from motor vehicle traffic as discussed earlier.

A *second* option is to provide either wide curb lanes or bicycle lanes over the bridge. This may be advisable where:

1. A one-way bicycle path becomes a bicycle lane at one end of the bridge which will allow the cyclist to cross in the same direction as motor vehicle flow; and,
2. Sufficient width exists or can be obtained by widening or restriping.

A *third* option is to use existing sidewalks as one-way or two-way facilities. This may be advisable where:

1. Conflicts between bicyclists and pedestrians will not exceed tolerable limits; and,
2. The existing sidewalks are adequately wide.

Because of the large number of parameters involved in retrofitting bicycle facilities onto existing bridges, compromises in desirable design criteria are often inevitable. Therefore, the width to be provided is often determined by the designer, on a case by case basis, after thoroughly considering all the parameters.

3.60 Drainage

The recommended minimum pavement cross slope of 2 percent adequately provides for drainage. Sloping in one direction instead of crowning is preferred and usually simplifies the drainage and surface construction. A smooth surface is essential to prevent water from ponding and potential ice formation in certain areas. Where a bicycle path is constructed on the one side of a hill, a ditch of suitable dimensions should be placed on the uphill side to intercept the hillside drainage. Such ditches should not create hazards for bicyclists. Where necessary, catch basins with drains should be provided to carry the intercepted water under the path. Where possible, drainage grates and manhole covers should be located outside of the travel path of bicyclists. To assist in draining the area adjacent to the bicycle path, the design should include considerations for preserving the natural ground cover. Seeding, mulching, and sodding of adjacent slopes, swales, and other erodible areas should be included in the design plans.

Lighting

Fixed-source lighting reduces conflicts along paths and at intersections. In addition, lighting allows the bicyclist to see the bicycle path direction, surface conditions, and obstacles. Lighting for bicycle paths is important and should be considered where cyclists riding at night are expected, such as bicycle paths serving college students or commuters, and at highway intersections. Lighting should also be considered through underpasses or tunnels, and when night-time security could be a problem. Depending on the location, average maintained horizontal illumination levels of 0.5 foot-candle (5 lux) to 2 foot-candle (22 lux) should be considered. Where special security problems exist, higher illumination levels may be considered. Light standards (poles) should meet the recommended horizontal and vertical clearances. Luminaries and standards should be at a scale appropriate for a pedestrian/bicycle path.

3.6 BICYCLE SAFETY

Cycling is regarded by most to be a dangerous activity. Undoubtedly the belief that cycling is unsafe is one of the greatest deterrents to cycling. Occasionally cyclists will experience an accident due to their own negligence, inclement weather or road conditions. These spills most often result in nothing more than superficial injuries, it is not until cyclists begin to merge with other modes of transportation in an urban setting do they sustain fatal or serious injuries. This section reviews accident statistics for bicyclists and

examines the cost paid for in terms of human suffering and property damage. It concludes with the presentation of possible solutions to alleviate some of the causes of accidents.

3.61 Bicycle Accident Statistics

The number of cyclists killed or seriously injured on Provincial roads has continually been on the increase over the last few years. Table 24 lists cases recorded over the past six years.

Table 24 Bicycle/Motor Vehicle Collisions Reported in Manitoba

	1981	1982	1983	1984	1985	1986	1987	% change from 1986
Number of Accidents (including fatalities)	271	292	306	348	338	326	402	**+23.3%**
Number of Injuries	234	264	279	208	221	231	364	**+57.6%**
Number of Fatalities	8	1	1	3	3	5	7	**+40.0%**
Property Damage (in 000's) (estimated)	n/a	n/a	$63	$70	$66	$94	$124	**+34.0%**

Source: The Manitoba Public Insurance Corporation, *An Analysis of Bicycle/Motor Vehicle Collisions 1981-87*, p.1.

Unfortunately these statistics do not accurately reflect the actual number of accidents and thus are at best, crude indicators of trends and should be interpreted as such. Many cycling accidents are of a superficial nature and as such fail to get reported to police. Thus they do not become included in the official statistics. Whereas the driver of a motor vehicle involved in an accident must, by legislation, inform the police. It is impossible to determine the extent of the unreported accidents but some estimates place the ratio of reported to unreported accidents, as high as 1:4, others claim it to be as high as 1:10. The Vancouver, B.C. bicycle study estimated that 65% of all bike accidents go unreported. If these figures were extrapolated to Manitoba, there may have occurred a minimum of 1 600 to a maximum of 4 000 possible accidents in Manitoba in 1987. Generally the more serious the accident, the less likely it will go unreported. Table 25 indicates the severity of the injury sustained to the cyclists for bicycle accidents during the last five years.

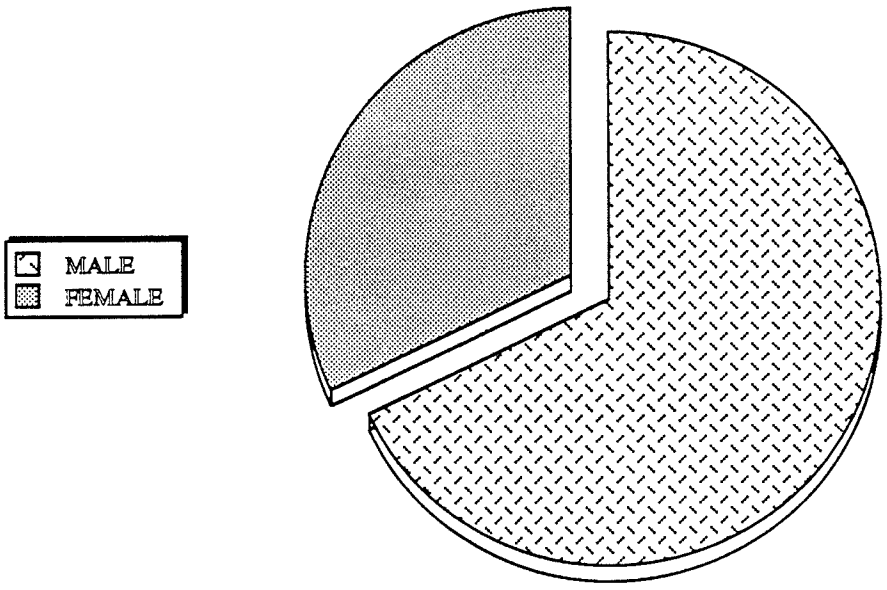
Table 25 Personal Injuries Sustained in Cycling Accidents

	1983	1984	1985	1986	1987
Slight Injury Incurred	235	168	184	189	350
Serious Injury Incurred	44	40	37	42	14
Fatal	1	3	3	5	7
Not Injured	23	80	99	52	25
Unknown	6	64	17	42	10

Source: The Manitoba Public Insurance Corporation, *An Analysis Of Bicycle/Motor Vehicle Collisions 1983-87*, p.3.

Detailed information on the type of injury sustained in cycling accidents was procured through the resources of the Manitoba Health Services Commission. The MHSC recorded every cycling accident that required at least a minimum of one night stay in hospital. For the year 1 April 1987 to 31 March 1988, there were 270 cyclists requiring a stay in hospital. It should be noted that included in this total were 8 cyclists whose injuries necessitated a return trip to the hospital as a result of the original accident. Figure 29 depicts the sex of those injured.

FIGURE 29 SEX of INJURED CYCLISTS

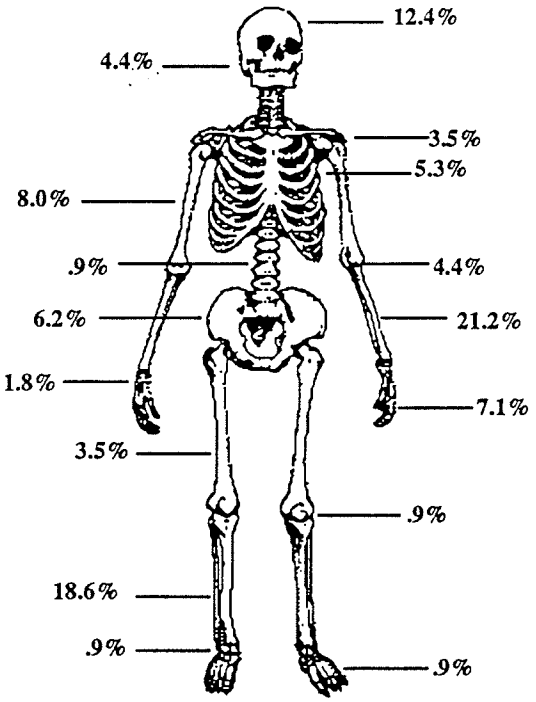


Source: Manitoba Health Services Commission, 1 April 1987 - 31 March 1988.

The 270 injured cyclists required a total of 1 179 overnight stays in Provincial hospitals. Further to this, those injured required 190 medical procedures which ranged from an overnight stay to immobilize a dislocated elbow, to extensive surgery requiring the injured to remain in hospital for 116 nights. These figures do not include those treated as

out-patients. The location of injuries and their occurrences are illustrated in Figure 30. The most common injuries sustained, in descending order, are: Radius and Ulna (arm); Tibia and Fibula (leg) and Head. The arms are injured in most accidents were the cyclist extends his arms to brace himself, this frequently results in a dislocation, abrasion or fracture. The legs become injured most often when the cyclist is struck by a vehicle. In almost all accidents the cyclist cannot protect his head during the fall and strikes his head on the pavement. This is especially prevalent among children. Failure to wear a helmet exposes the cyclist to even more serious injuries. Two bicycle counts taken this past summer in Winnipeg revealed that less than 3.5% of cyclists used helmets. In addition, 7.6% of cyclists during the May count were observed wearing a personal walkman.[1]

FIGURE 30 LOCATION and FREQUENCY of CYCLING INJURIES



Sample Size = 113 Cyclists

Source: Manitoba Health Services Commission, 1 April 1987 - 31 March 1988.

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[1] The first count was conducted in May 1988 at the corner of Bannatyne Avenue and Main Street. From 10:30 AM to 12:30 PM a total of 56 cyclists were observed. Many of them performed cycling manoeuvres that were in direct contravention of the law. Infractions included: riding on the sidewalk, going through red lights, and travelling in the opposite direction of traffic. The second count was taken at Waverley Street and Wellington Crescent in June 1988. The road was only open to local traffic this Sunday and 375 cyclists used this opportunity between the hours of 11:20AM and 1:00 PM.

Commission statistics also illustrate the frequency and location of accidents throughout the Province that required some hospitalization. Table 26 lists the six most frequent sites where accidents occurred that were of a more serious nature. Not surprisingly downtown Winnipeg is by far the number one site in the Province. The overcrowded conditions in the downtown helped contribute to this total.

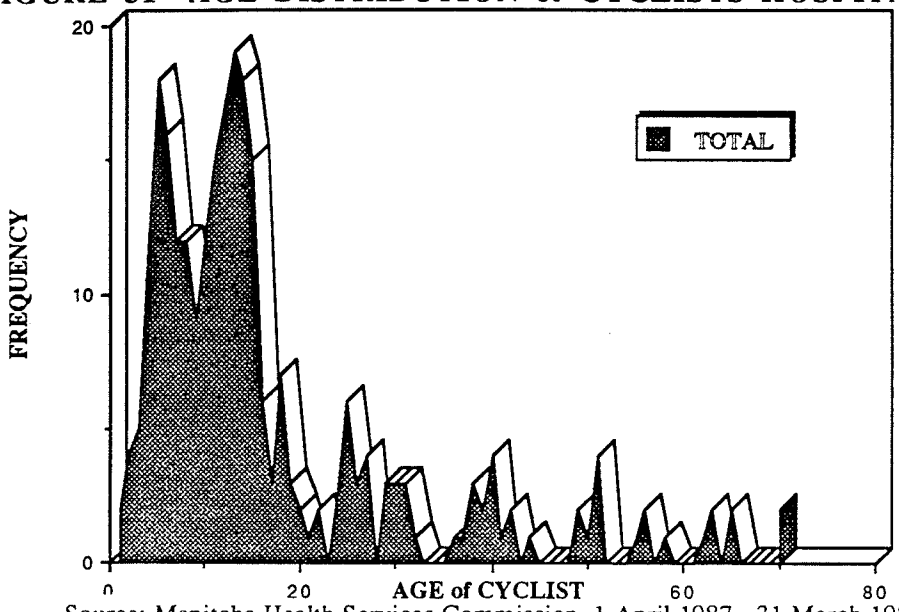
Table 26 Accident Locations in Manitoba

WINNIPEG - INNER CITY	17%
WINNIPEG - ST. JAMES	6%
WINNIPEG - ST. BONIFACE	5%
WINNIPEG - EAST KILDONAN	4%
WINNIPEG - ST. VITAL	4%
WINNIPEG - WEST KILDONAN	4%

Source: Manitoba Health Services Commission, 1 April 1987 - 31 March 1988.

Figure 31 highlights the age distribution of those injured that required hospitalization. The range is from one-year old to over seventy years of age. The median age is 13. When these figures are compared to the age distribution for all collisions which involved cyclists, it is apparent that the youth are over-represented and adults under-represented. This reflects the vulnerability that a small person has when involved in a collision with a motor vehicle and the ability of an adult to evade serious injury. Cyclists under 15 years of age are more likely, than any other group, to be involved in an accident per trip made. Whereas older cyclists are the safest. This is indicative of the difficulties of training children to appreciate the dangers of using the roads and to behave in a manner which minimizes danger.

FIGURE 31 AGE DISTRIBUTION of CYCLISTS HOSPITALIZED



Source: Manitoba Health Services Commission, 1 April 1987 - 31 March 1988.

When a road accident occurs, costs are incurred by those involved and the community as a whole. The costs to be considered include those arising from:

Police and administration,
Medical and ambulance services,
Damage to property,
Lost output/productivity
Pain, grief, and suffering

The cost of an accident will therefore vary according to the people and vehicles involved. Cost estimates of bicycle accidents determined by Hudson in Great Britain would result in 1987 Canadian dollars of $4 320 CDN[1] (average cost) for an accident and $183 600 CDN[2] (average cost) for a fatality (Hudson 1982:40). Thus, in 1987 it is roughly estimated that the 402 cycling accidents and 7 fatalities cost Manitoba a total of $3.0 million dollars.[3]

The figures describe those requiring hospitalization and those whose injuries necessitated some form of medical procedures. The total cost of treating the injured is difficult to determine but the figure is considerable. Hudson attempts to place a cost figure

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[1] £2000 pounds sterling in 1982, converted to Canadian currency at the yearly average rate of 2.16CDN = £1. Rates provided by the Bank of Canada.

[2] £85 000 pounds sterling in 1982, converted to Canadian currency at the yearly average rate of 2.16CDN = £1. Rates provided by the Bank of Canada.

[3] Conversion of 1982 dollars to 1987 dollars using a Consumer Price Index of 138.2.
1987 CPI/1982 CPI * 1982 = 1987 cost. CPI figures provided by Statistics Canada.

on cycling accidents and in Manitoba this total exceeds $3 million dollars for 1987. Many of these costly accidents could have been prevented through various bicycling initiatives. These include: the upgrading of cycling skills programs to reach more cyclists; the provision of bicycle facilities; and the enhancement of the drivers education program for motorists to learn the skills necessary to drive while sharing the roadway with cyclists.

The City of Winnipeg, department of Streets and Transportation collates bicycle collision information as part of the annual report, *Traffic Collisions*. The age of cyclists involved in bicycle collisions is detailed so that it becomes possible to compare with age cohorts for the entire city. From Table 27 it can been seen that the age group 10 - 24 is over-represented in the number of accidents that they are involved in, when compared to their frequency in the general population. Sixty-one percent of all bicycle collisions in 1986 are attributed to the 10 to 24 years old. Yet their composition in the city population is closer to 24 percent of the total. This leads to the assumption that they are involved in more accidents because they: travel more distance by bicycle and/or travel more frequently, and ride in routes that place the cyclist in a precarious position, etc. thus exposing them to greater opportunities for accidents.

Table 27 Age of Bicyclists Involved in Collisions in Winnipeg

			Winnipeg - Population*		Bicycle Collisions
Age	Collisions	%	Total	% of Total	per 10 000 population
0 - 4	0	0.0	41 978	6.8	0.0
5 - 9	23	8.7	39 550	6.4	5.8
10 - 14	**60**	**22.6**	**40 576**	**6.6**	**14.8**
15 - 19	**48**	**18.1**	**44 593**	**7.2**	**10.8**
20 - 24	**55**	**20.8**	**59 715**	**9.7**	**9.2**
25 - 34	43	16.2	115 738	18.8	3.7
35 - 44	14	5.3	84 700	13.7	1.7
45 - 54	7	2.6	58 035	9.4	1.2
55 - 64	4	1.5	56 997	9.3	0.7
65 - 74	5	1.9	44 413	7.2	1.1
75 +	1	0.4	29 812	4.8	0.3
Not Stated	5	1.9			
TOTAL	**265**	**100.0**	**616 107**	**100.0**	**4.3**

* As of 1 June 1986 MHSC
Source: City of Winnipeg Department of Streets and Transportation, *1986 Traffic Collisions*, p.65.

With the proper attire and bicycle equipment, cycling is one of the few sports that can be pursued on a year long basis and practiced both night and day. But due to the

inclement conditions of Winnipeg winters and the possibility of not being seen at night, many cyclists switch to alternate modes of transport during these times. However, accident statistics indicate that there are some cycling enthusiasts who use their bicycle during these times when conditions are somewhat less than ideal. This practice does place them at a higher risk of being involved in an accident. Table 28 indicates the time of day that cycling accidents occurred in Winnipeg for 1986. This table does not indicate the level of cycling but rather the frequency and the time when an accident occurred involving bicycles. It is important to note that cycling is enjoyed throughout the entire day. The time of 4 pm to 7 pm comprises 35.5% of all accidents. This isn't surprising as the city streets become crowded during the rush hour, placing cyclists in a precarious position, and increasing the likelihood of an accident.

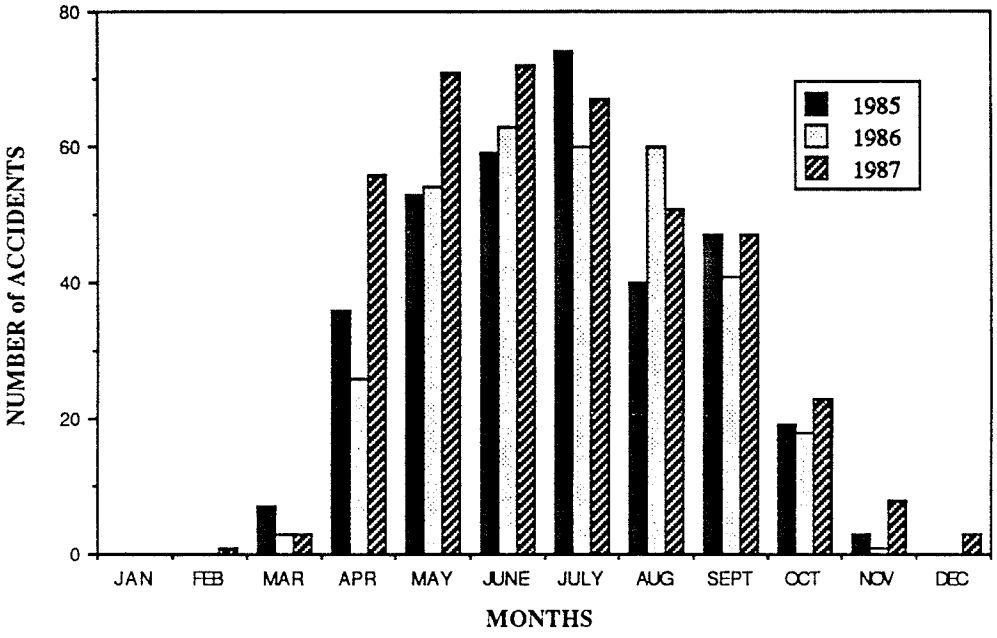
Table 28 Time of Day of Bicycle Collisions in Winnipeg

	FATAL COLLISIONS		INJURY COLLISIONS		TOTAL COLLISIONS	
Time of day	Occasions	%	Occasions	%	Occasions	%
12 - 1 AM	0	0.0	4	1.6	4	1.5
1 - 2 AM	0	0.0	3	1.2	3	1.1
2 - 3 AM	0	0.0	0	0.0	0	0.0
3 - 4 AM	0	0.0	0	0.0	0	0.0
4 - 5 AM	0	0.0	0	0.0	0	0.0
5 - 6 AM	0	0.0	2	0.8	2	0.8
6 - 7 AM	0	0.0	3	1.2	3	1.1
7 - 8 AM	0	0.0	3	1.2	3	1.1
8 - 9 AM	0	0.0	13	5.2	14	5.3
9 - 10 AM	0	0.0	4	1.6	5	1.9
10 - 11 AM	0	0.0	4	1.6	4	1.5
11 - 12 AM	0	0.0	4	1.6	4	1.5
12 - 1 PM	0	0.0	19	7.5	20	7.5
1 - 2 PM	0	0.0	18	7.1	18	6.8
2 - 3 PM	0	0.0	22	8.7	24	9.1
3 - 4 PM	0	0.0	18	7.1	18	6.8
4 - 5 PM	**0**	**0.0**	**39**	**15.1**	**40**	**15.1**
5 - 6 PM	**0**	**0.0**	**27**	**10.7**	**27**	**10.2**
6 - 7 PM	**1**	**100.0**	**23**	**9.1**	**27**	**10.2**
7 - 8 PM	0	0.0	13	5.2	13	4.9
8 - 9 PM	0	0.0	11	4.4	11	4.2
9 - 10 PM	0	0.0	10	4.0	12	4.5
10 - 11 PM	0	0.0	4	1.6	4	1.5
11 - 12 PM	0	0.0	7	2.8	8	3.0
Not stated	0	0.0	1	0.4	1	0.4
TOTAL	1	100.0	252	100.0	265	100.0

Source: City of Winnipeg Department of Streets and Transportation, *1986 Traffic Collisions*, p.66.

Figure 32 depicts the number of collisions that occurred over the last three years, on a monthly basis. The chart shows the increasing number of accidents that are taking place during the winter months as cyclists stretch the cycling season as long as possible. The number has increased in winter months like November, and accidents are occurring in February and December for the first time in 1987.

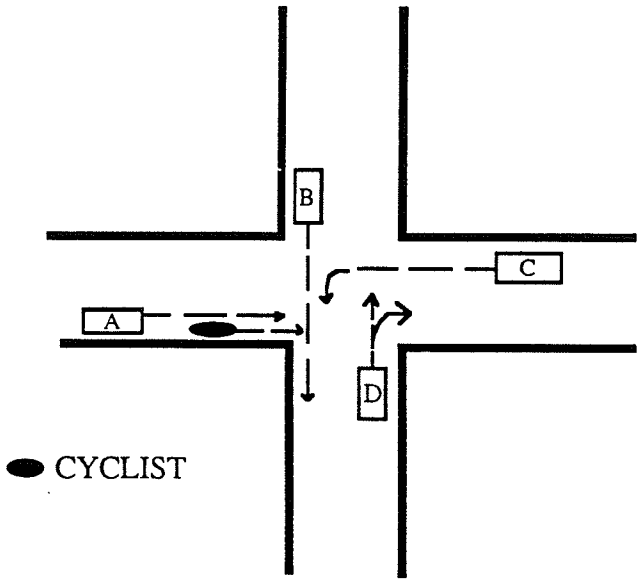
FIGURE 32 BICYCLE ACCIDENTS by MONTH



Source: Manitoba Public Insurance Corporation,
An Analysis of Bicycle/Motor Vehicle Collisions 1985-87, p.3.

The most frequent location for bicycle/car collisions to occur, is at the intersections. In 1986 in Winnipeg, 54% of all accidents occurred at the intersections. In contrast, 43% of accidents occurred at mid-block locations. Intersections pose a special problem to cyclists as it is here that they encounter vehicles travelling in four different directions and countless numbers of pedestrians. Figure 33 illustrates the variety of traffic manoeuvres that are characteristic of intersections.

FIGURE 33 INTERSECTION MANOEUVRES



Motorist "A" is travelling in the same direction as the cyclist. The motor vehicle is described as an **approaching** vehicle, he may continue in the direction of the cyclist or turn right across his path. Motorist "B" is moving in a direction perpendicular to the path of the cyclist. The motor vehicle is described as a **passing** vehicle. The motorist's path of travel will intersect the cyclist's path or he may turn left into the same path. Motorist's "C" is moving in a direction that is opposite to the path of the cyclist. In this case, the motor vehicle is described as an **oncoming** vehicle. He may turn left across the cyclist's path or perform a U-turn and travel in the cyclist's path. Similar to motorist B, motorist "D" is a passing vehicle, whose path may take him across the cyclist's path or along the same path.

Table 29 depicts the various types of collisions within Winnipeg. The three most frequent causes of bicycle collisions comprise 87% of all accidents. Of those, 76% occur at intersections. The most common cause (45%) is when a motorist, type A, turns across the cyclist's path. The second most frequent (23%) usually occurs at mid-block locations by approaching motorists, type A, and side swipes the cyclist. The third type (18.5%) is usually committed by oncoming motorists, type C, who turns left across a cyclist's path and continues on through. These figures are typical of what can be expected in an urban environment. Conversely, in a rural setting the numbers differ slightly. The percentage of turning and crossing type accidents decrease significantly, while accidents caused by approaching vehicles may reach as high as 40 percent. This is the result of numerous

attributes inherent in a rural environment, these include: faster speeds on rural roads, poor lighting conditions, less congested roads, longer sight distances, drivers less accustomed to encountering cyclists, etc. In Manitoba data for 1986 and 1987 recorded a total of 12 fatalities. Of these nine occurred on rural roads or high speed roadways. Approaching motor vehicles were responsible for eight deaths, an oncoming motorist caused one, and the remainder could not be determined due to the lack of information reported on the accident. It is important to note that four of the twelve drivers involved in these accidents were found to be driving under the influence of alcohol.

Table 29 Bicycle Collision Types in Winnipeg

	Fatal Collisions		Injury Collisions		Total Collisions	
Collision Type	Occasions	%	Occasions	%	Occasions	%
Rear-End	0	0.0	19	7.5	19	7.2
Right Angle	**1**	**100.0**	**111**	**44.0**	**120**	**45.3**
Left & Opposing Thru	**0**	**0.0**	**47**	**18.7**	**49**	**18.5**
Pedestrian	0	0.0	2	0.8	2	0.8
Head On	0	0.0	4	1.6	4	1.5
Side Swipe	**0**	**0.0**	**59**	**23.4**	**61**	**23.0**
Fixed Object	0	0.0	2	0.8	2	0.8
Overturn	0	0.0	8	3.2	8	3.0
Leave Roadway	0	0.0	0	0.0	0	0.0
Non-Collision	0	0.0	0	0.0	0	0.0
Other	0	0.0	0	0.0	0	0.0
TOTAL	**1**	**100.0**	**252**	**100.0**	**265**	**100.0**

Source: City of Winnipeg Department of Streets and Transportation, *1986 Traffic Collisions*, p.67.

Hudson, in his book *Bicycle Planning Policy and Practice*, concludes that in Western countries, that between 70 and 80% of all bicycle accidents occur during daylight hours. But he cites a Danish study which indicates that cycling at night places the cyclist at a higher risk of being involved in a fatal accident. Statistics for Manitoba support this hypothesis as Table 30 illustrates. Daytime accidents over the last three years has consistently hovered over the 80% mark. Of the daylight accidents in 1987, .9% resulted in fatalities. This figure rises to 9.3% when examining the night time accidents.

Table 30 Cycling Accidents as a Function of Lighting Conditions

	1985					1986					1987				
			Injury					Injury					Injury		
	TOTAL	%	SL	SE	F	TOTAL	%	SL	SE	F	TOTAL	%	SL	SE	F
Daylight	299	88.5	184	37	3	268	82.2	189	42	5	341	84.8	319	14	3
Darkness	13	3.8	4	0	1	41	12.6	17	6	1	43	10.7	31	0	4
Dawn	5	1.5				3	0.9				3	0.7			
Dusk	21	6.2				13	4.0				15	3.7			
Unknown	-	-				1	0.3				-	-			

SL - slight injury SE - serious injury F- fatal

Source: The Manitoba Public Insurance Corporation, *An Analysis of Bicycle/Motor Vehicle Collisions 1985-87*, p.4.

Inclement weather may be thought to be a cause of many accidents. Rain, for instance, makes the road slippery and difficult to negotiate with the narrow tires, furthermore, wet brakes will seriously inhibit the ability of a cyclist to stop quickly should the need arise. The rain also affects motorists, it reduces their visibility thus making it more difficult to detect cyclists. However, as Tables 31 and 32 illustrate, the correlation between the large number of accidents and ideal weather conditions, (clear skies and dry streets) can be seen. It can probably be assumed that the low number of accidents during inclement weather conditions is due to fewer cyclists using the streets when the weather is less than ideal.

Table 31 Cycling Accidents as a Function of Weather Conditions

Weather	Fatal Collisions		Injury Collisions		Total Collisions	
Condition	Occasions	%	Occasions	%	Occasions	%
Clear	0	0.0	208	82.5	219	82.6
Cloudy	1	100.0	36	14.3	37	14.0
Rain	0	0.0	8	3.2	9	3.4
Snow	0	0.0	0	0.0	0	0.0
Freezing Rain	0	0.0	0	0.0	0	0.0
Other	0	0.0	0	0.0	0	0.0
TOTAL	1	100.0	252	100.0	265	100.0

Source: City of Winnipeg Department Streets and Transportation, *1986 Traffic Collisions*, p.69.

Table 32 Cycling Accidents as a Function of Street Condition

Street	Fatal Collisions		Injury Collisions		Total Collisions	
Condition	Occasions	%	Occasions	%	Occasions	%
Dry	1	100.0	237	94.0	249	94.0
Wet	0	0.0	13	5.2	14	5.3
Slippery	0	0.0	0	0.0	0	0.0
Snowy	0	0.0	0	0.0	0	0.0
Icy	0	0.0	0	0.0	0	0.0
Other	0	0.0	2	0.8	2	0.8
TOTAL	1	0.0	252	100.0	265	100.0

Source: City of Winnipeg Department of Streets and Transportation, *1986 Traffic Collisions*, p.71.

It is worthwhile to gather data on every aspect of the many bicycling accidents. This data is invaluable as it will assist in the identification of a safety program for cyclists. The data should be processed to show whether accidents are common to a particular:

- Location,
- Type of road,
- Type of intersection,
- Type of manoeuvre,
- Environmental factor,
- Type of road user behaviour, or,
- Age group of cyclists.

The first step in processing accident data should be the production of an accident map for the area under study. Each accident that has occurred over some number of years proceeding the study can be plotted on the map. This will serve to elucidate any locations that may represent a major hazard to cyclists. Such locations might typically include:

- Section of a major road,
- School or park entrance,
- Major road junction, or,
- Shopping street.

Similarly, a particular type of location may be found to be dangerous to cyclists, although no one such location has a concentration of accidents. These might be any of the above, or others such as;

- Residential streets, or,
- Major/minor streets.

Once a particular location or type of location has been identified as being dangerous for cyclists, the next stage is to prepare a larger scale drawing of the location. This would allow the accidents to be seen diagrammatically. These drawings will show whether a particular type of manoeuvre is placing the cyclists at risk and enable remedial measures to

be implemented, or they will provide the basis for more detailed field studies. If a particular type of manoeuvre is identified as dangerous for one type of location, accidents at other types of similar locations should be examined to see whether the same type of manoeuvre is causing problems elsewhere. For example, it may be a turn across a line of motor vehicles at major/minor crossroads, at T-junctions or in shopping areas away from any junctions.

Causal Factors of Accidents

Comprehensive accident records should contain details of any factors which are considered to have contributed to each accident. These should relate to environment, behaviour and vehicular conditions. Typical causes might include:

- Environment: darkness, rain, peak hour vehicle or pedestrian flows, obstructed vision, poor road surface, substandard lighting, bright sunlight or heavy shadow.
- Cyclists' Behaviour: talking to friend, bicycle overloaded, racing, riding using no-hands, looking at shops, failing to signal, veering off line without warning, failing to see road sign, failing to stop, unsuitably clothed, wearing a walkman, drunk or under the influence of drugs.
- Motorists' Behaviour: speeding, failing to see road sign, disobeying road sign, failing to see cyclist, failing to signal, looking for unfamiliar destination, stopping suddenly, using unfamiliar vehicle, drunk or under the influence of drugs.
- Vehicular Conditions: lights, tires or brakes in poor condition, lights not turned on, steering defective, bicycle the wrong size, car windshield dirty.

Tabulations of all accidents in the area should be made. The most common factors contributing to bicycle accidents will become apparent and countermeasures can then be formulated.

The countermeasures required for a particular accident problem will vary according to the age and sex of the user involved in the accidents. Separate analysis should therefore be carried out for the four groups defined by the cohorts male/female and under/over 16 years of age. Further subdivisions by age that may prove practical are best suited to children rather than adults. A behavioural factor may be found to be common for a particular class of user, for example, failure to look prior to turning. From this, publicity and training measures can be devised to cope with this factor and schemes initiated at suitable locations such as schools, youth organizations, public buildings and work places.

To make an application for a drivers licence in the Province of Manitoba a person must be either: 18 years of age, or 16 years of age and receive consent from both parents, or 15 and one-half years of age and enrolled in the Driver Education Program. The applicant is then required to submit to and pass three examinations, which include a knowledge test, vision test and a road test. Upon successful completion of all three the applicant is then issued a one-year probationary licence. If the new driver is involved in any accidents or is issued a traffic offence, the licence can be revoked. In Manitoba there were 623 406 active drivers at the end of 1986, a 2.7 percent increase from 1985.[1] Also in 1986, there were a total of 99 049 written and oral examinations given in addition to 48 605 road tests conducted.[2] The Driver Education section of Driver and Vehicle Licencing administers the Provincial High School Driver Education Program. During the 1985-86 school year, 7 918 students completed driver education courses. Of these students fifty-seven percent were under 16 years of age, an increase of 3.0 percent from the previous year. A total of 269 instructors participated.[3] Complementing this effort to train new automobile drivers is the attempt to identify problem drivers and assist them in improving their driving capabilities. Also included in the mandate of the Driver Improvement and Control section is the responsibility to inform and educate the public on issues of drivers safety. Personnel from this department are available for speaking engagements at schools, service clubs, and other interested organizations upon request. The ultimate goal of the Driver Improvement and Control section is to reduce the number of fatalities, personal injuries, and property damage arising out of traffic accidents. By monitoring a driver's involvement and taking appropriate action, the DIC section endeavours to make the roadways a safer place. As such, 14 004 driver improvement interviews were conducted in the Province of Manitoba in 1986. This resulted in 4 588 licence suspensions under Section 273 of the Highway Traffic Act.[4] This massive educational and enforcement effort aims to teach people how to operate their vehicle and behave according to a common set of rules.

It is therefore extraordinary that the government would allow cyclists to use the identical network of roads that these well-trained motorists use, and expect them to know and behave according to the same set of rules with no formal training whatsoever. Furthermore, children who possess a poorer perception of speed and direction, are more

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[1] Manitoba Highways and Transportation, *1986 Statistical Report*, pii.
[2] Ibid, pvi.
[3] Ibid, pvii.
[4] Ibid, pxii.

vulnerable to serious injury in an accident, with less physical ability to control their bicycles and less common sense, are expected to share the roads. As a result, numerous children are injured or killed each year in accidents with motor vehicles that were most often the result of their own ignorance or bad behaviour. The major obstacle in ameliorating this problem is that both motorists and cyclists believe that it is the other that needs to be controlled and educated. From the cyclists' viewpoint, the roads were relatively safe before the use of private motor vehicles and heavy goods trucks became widespread; therefore, since motor vehicles cause the problem, the solution lies in controlling their use. However, from the motorists point of view, the accident problem is caused by cyclists not understanding and failure to obey the rules of the road. Unfortunately there is no thorough study done on bicycle/car collisions in Winnipeg that would clarify the situation. This problem is further complicated by the inability of the City Police to collect all the data necessary from cycling accidents that would allow the apportioning of blame. In response to the escalating number of accidents in off-road vehicles the Provincial Government has introduced legislation that attempts to prevent accidents (especially those involving children) and reduce property damage. It is called the Off-Road Vehicles Act and it took effect 1 October 1988. It requires: the registration of all off-road vehicles; the mandatory third party liability insurance for each vehicle, the prohibition of youth under the age of 14 from operating the vehicle unless supervised by a parent, and the compulsory use of safety helmets for all operators and passengers. The ongoing conflict between motorists and cyclists was clearly expressed this summer by the numerous letters to the *Winnipeg Free Press* and a columnists rebuttal. The pro-cycling letters point out the various incidents that they have endured or witnessed and ask for better education for both motorists and cyclists. They also concede that many cyclists do fail to obey the rules of the road but insist that they are in the minority. However, a column in the *Free Press* in late July illustrated the extreme of anti-cycling sentiments.[1] The column labelled cyclists as a "dangerous, irritating and frustrating hazard to Manitoba motorists". The author is of the opinion that the majority of cyclists fail to obey the traffic laws and that they are allowed to use the city roads that the motoring public has paid for through various taxes and fees. It appears that neither faction really understands the needs and aspirations of each other. Thus, what is required, is an education program designed to heighten the awareness of both cyclists and motorists and encourage the safe sharing of the roads.

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[1] Columnist Fred Cleverley's article appeared in the 18 July 1988 edition of the *Winnipeg Free Press*.

3.62 Bicycling Safety Programs

The Manitoba Public Insurance Corporation, through the Bicycle Safety Department, offers a bicycle safety training program. The program is accessed by school teachers who assist in the delivery of the instructional material in an attempt to broaden the level of understanding of the traffic rules to elementary schools in the Winnipeg, Selkirk, Brandon and Thompson areas. This is accomplished in two ways. The first method provides a fully trained instructor to interested schools for a one-week period. During this week the instructor presents the program to four groups of 35 students. The activities include the inspection of the bicycle, demonstration of cycling ability and a traffic rules knowledge test. This program is the most comprehensive form of bicycle safety education that a child may receive in Manitoba. The second method offers instructional materials to schools for presentation by faculty members. Material includes cycling skills games, bicycle resource books, and films on a variety of topics which includes safe cycling, bike maintenance, traffic laws, etc. In 1986 the Bicycle Safety Program instructed 26 662 individuals as to proper and safe cycling principles. In addition, there were almost 17 000 copies of the *Bike Book* distributed.[1]

Supplementing the efforts of the public corporation, are those of the Right-Riders program sponsored by Petro-Canada. The program is available to children aged three to 12 who can earn a "licence" for the successful completion of a specially-designed course that tests their basic knowledge of the rules of the road. The program seeks to promote safe bicycle use by exposing children to the basic components of the Highway Traffic Act, in the hopes it will provide them with a better idea of how their performance on a bicycle can put them in jeopardy. The program is free to the public and begins with a short audio-video presentation which gives the children a basic introduction to the rules of the road. They are then allowed to practice their skills on a course laid out in a miniature village setting. The village has animated characters, natural landscaping and all the traffic signs and lights as would be found on actual roads. There is also a Right-Riders video presentation that has been introduced to more than 13 000 schools across the country, exposing more than 4 million children to the principles of safe bicycling. The Winnipeg Cycletouring Club (WCC) also offers courses for adults wanting to upgrade their skills. In addition, a group of concerned cyclists joined together to form an organization called

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[1] Manitoba Highways and Transportation, *1986 Statistical Report*, p.53.

B.I.K.E.S.[1] Their mandate is to increase public awareness and education on the topic of cycling safety.

3.63 Development of an Education Program

There are three essential prerequisites for a successful education program.. First, it must address the behaviour of both cyclists and motorists. Second, it requires the support of enforcement agencies. Without the threat of enforcement, people tend to consider their own interests (e.g., getting somewhere quickly) and not the risks that they are incurring. The third necessary ingredient of an education program is its permanence. Numerous behavioural studies have shown that unless an individuals' habits, and particularly those of children, are regularly reinforced, they tend to return to their former ways. An education program will therefore have to both, train new cyclists and drivers, and improve the behaviour of existing cyclists and drivers. As mentioned earlier, Manitoba already has a childrens education program, however the accident statistics indicate that the current efforts are inadequate or fail to reach those with the greatest need. The education programs need to be consolidated to ensure that they are uniformly administered to all school children. Currently a child does not gain exposure to such programs unless the teacher specifically requests the program. Thus it is necessary to make it mandatory that each student is exposed to a comprehensive safety concepts and skills development program oriented to their level of ability.

The first priority is to determine the exact nature of the safety problem. This would be accomplished by a thorough analysis of all accidents and any causes which may have precipitated the accident. These statistics can be used to focus attention on the problem, and to argue for the allocation of sufficient funds to tackle the problem on a realistic basis. They will also assist with the determination of priorities within the overall program. In the majority of cases school children will undoubtedly be the group requiring the most attention. In Winnipeg over 31% of all bicycle accidents involved cyclists under the age of 15 years old. Within this group, statistics indicate that the largest proportion of accidents involve boys aged between 10 and 14. The Ontario Ministry of Transportation recently launched a new bicycle safety campaign during the summer of 1988 that emphasized;

Following the rules of the road,
Being seen at night, and

[1] Bicyclists Interested in Knowledge and Education for Safety.

Sharing the road with other vehicles,
(Ontario Government Ministry of Transportation, News Release, 20 May 1988)

These three topics were chosen as the focus because in Ontario, these were seen as the three major leading causes of accidents. This campaign also included radio commercials and the formulation of the new *Cycling Handbook* that is aimed specifically at adults and teens, as information for this target group was lacking. The improvement of motor vehicle drivers' awareness of cyclists will also be a priority. As they are involved in almost all the bicycle accidents that result in serious or fatal injuries to cyclists. In Manitoba the *Driver's Handbook* is available to assist applicants in learning the skills necessary to become a safe licenced driver. However, it provides very little information on how a motorist should react when encountering a cyclist. The book is woefully inadequate as it lacks any diagrams or illustrations and only lists a minimum of seven 'helpful tips' that are an attempt to warn motorists of the potential for collisions with cyclists.[1] The handbook is written totally from the viewpoint of motorists virtually ignoring bicyclists. As the sole teaching resource that all potential drivers rely on, this document is insufficient. It becomes obvious that a more thorough and accessible teaching program is required in anticipation that it may prevent bicycle/motor vehicle collisions.

Education

The goal of bicycle education in schools is to teach all children how to ride bicycles safely in all traffic conditions. This goal can be broken down into a number of requirements which will be essential to any course of bicycle education. These include:

- An ability to ride safely in traffic;
- An understanding of the rules of the road;
- Habits of care and alertness;
- An ability to make decisions in traffic and respond to the hazards of the roads; and,
- Knowledge of how to maintain bicycles.

(Mike Hudson, *Bicycle Planning Policy and Practice*, p.97.)

This is clearly a massive task which will require considerable resources. An effective method of encouraging children to participate in bicycle safety education is to present some form of a cycling award or certificate, upon the successful completion of the course. It then becomes mandatory for a cyclist to possess one as a condition of cycling to school and

[1] Manitoba Highways and Transportation, Driver and Vehicle Licencing, *Driver's Handbook*, p.46.

keeping a bicycle on the school grounds. The aim should be to create a climate in which this award is highly desirable, thus encouraging excellence in this subject.

Analysis of the types of accidents in which children are involved identifies areas of training which should be given special attention. Although little research has been done comparing the different types of accidents in which children and adults are involved, there is evidence to suggest that they are similar. Thus the five main types of accidents listed below, should therefore be used as a basis for teaching manoeuvres which require special attention.

1 Cyclist turns into side road,
2 Cyclist emerges from side road,
3 Motorist overtakes cyclist,
4 Cyclist rides off main path into traffic,
5 Motorist emerges from side road.

Parental guidance is a major factor influencing childrens' behaviour. Unfortunately, many parents do not seem to recognize bicycle safety as an area of lasting priority. Most often the parents provide the bicycle and a few instructions, such as "watch for cars" and "ride carefully". Once this is achieved the child's safety is left in the hands of fate. The major aim, therefore, is to instill in parents the importance of systematically teaching children about the hazards of the roads and how to overcome them. The problem can be split into two parts: firstly, alerting parents to the existence of the problem, and secondly, giving them the information to either teach the children themselves or send their children to classes. The use of parents to teach children bike safety will supplement those already available, but will also serve to reach a greater number of children and do so much more frequently. In addition, the lessons learned by one child are often passed on to others. The next step is to provide some basic information about bicycle safety and this is best facilitated through the communication media. Information pamphlets which outline bike safety and list locations available for learning correct bicycle operations, could be attached to every new bicycle sold and bikes brought in for repairs. Additional copies could be left at bicycle shops, libraries, schools, shopping malls and similar places. To notify parents of existing cyclists, articles could be placed in local newspapers and distributed to organizations and communities who publish their own newsletters, TV spots on community TV stations, and notices could be included with mailouts from public corporations like Hydro, MTS, Autopac, etc. These would supplement the previously mentioned efforts in an attempt to attract parents of new cyclists. A successful program

requires some publicity, an enthusiastic organization to undertake the initiative and some interesting activities.

Educating Adult Cyclists

The greatest difficulty in attempting to teach bicycle safety to adults is finding ways of communicating with those who most need the training. Attention should therefore be directed at attempts to communicate through carefully chosen media.

Accident statistics suggest that the most important group is the 10 - 24 age group. The popular interests of this group should therefore be identified and communication about their interests should include safety facts and figures, details pertaining to accident trouble spots with high incidences (both geographic locations and operating procedures) and tips about surviving in traffic.

Another effective means of communication is undoubtedly television. However, the cost may be prohibitive, thus a campaign should be aimed at cyclists and other road users. The major drawback is that this medium suffers from the problem that some people return to their old habits when the campaign is over. The main objective is to educate adult cyclists about bicycling safety and the possible ways of improving their riding skills and predictability as roadway users. This may be best accomplished through a variety of initiatives, which include:

i
- Develop and publicize a range of cycling programs through parks and recreation, schools, colleges, etc.
- Target toward areas of greatest interest and utility for adult cyclists, including adults seeking information for improved riding, and other adults identified by law enforcement officers as needing additional training.
- Programs would be included for cyclists at any level of skill (e.g., learning to ride, commuter cyclists, weight control/exercise, race training).
- Offer on-bike training instruction.

ii Encourage the formation and activities of adult bicycle clubs. The establishment of a strong network of clubs with an active program of interesting activities will put people into contact with more conscientious cyclists.

iii Develop adult-oriented bicycle education literature and a pool of knowledgeable speakers, all available for presentations at service clubs, parks, church groups, bike shops, shopping malls, public institutions, and local organizations.

iv Encourage the development of bicycle education and training programs with a focus on senior citizens.

v Work with the local media to provide spots on public service

announcements and community stations and a newspaper column dealing with bicycle safety and education topics.

Educating Motor Vehicle Drivers

Considerable effort is already put into road safety campaigns that try to persuade people not to drink and drive, to wear seatbelts, use helmets and so on. The task of those responsible for bicycle safety is to ensure that this aspect of road safety is also included in the campaign.

Large numbers of cyclists are the innocent victims of the improper behaviour of motor vehicle drivers. Furthermore, practically every cyclist can produce a list of near misses incurred or witnessed during their cycling excursions. The purpose of educating motor vehicle drivers is two-fold: firstly, to improve their behaviour, and secondly, to show cyclists that both facets of the bicycle safety problem are being tackled. A study in Toronto has revealed that of the car/bike collisions in the city, motorists were at fault 60% of the time and cyclists 40%.[1] London, Ontario reported 263 bicycle/motor vehicle collisions during 1986. There were no charges laid in 50% of the accidents but of the remaining 130 collisions, motorists were found to be at fault in 38% of the cases and cyclists 12%.

The opportune time to initiate a program is when people are learning to drive. Information about accident types, their causes and the characteristics of bicycles should be provided during driver lessons to instil the ideas of maturity and courtesy which are essential elements of safety on the roads. This information could be included in the *Driver's Handbook* and other documents used by the learning drivers. It should also be included in all driver tests.

When people learn to drive other types of vehicles, such as heavy goods vehicles, transit buses, etc. further instruction should be given on the responsibilities of vehicle drivers. In particular, operators of large vehicles should be taught and questioned about the allowances that should be made when the driver is overtaking a cyclist. As they occupy a significant portion of the roadway, their presence produces a vulnerable situation for the cyclist who suddenly becomes limited in the amount of manoeuverability he/she has. For example, Winnipeg Transit requires its driver trainees to undergo an intensive two month training period when learning the operating procedures of a city bus. Unfortunately the

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[1] *Financial Post*, 18 January 1988, p.16.

current program makes the ill-conceived assumption of classifying bicyclists and motorcyclists into the same group of potential road hazards. Even though each has very different operating characteristics. They are mentioned briefly as potential hazards and trainees are taught two important lessons. First, they are instructed to pull as close to the curb as possible when stopping for passengers, this ensures that cyclists will pass the bus on the left side where they are more visible to the driver. And secondly, when overtaking a cyclist the bus should pull out a minimum of six feet so if the cyclist should fall he/she would not be in the path of the bus. These lessons are valid but fall short of what is really required, as there is still numerous conflicts between cyclists and buses, and the potential exists for more as the city operates, on average, 450 buses on the streets at any one time. A spokesman for the Transit company acknowledged the shortcomings of the program, but indicated that they are presently reviewing their training procedures and are considering new approaches to accommodate the growing number of cyclists.[1] However, their actions will only affect a very small proportion of the current motoring population. Further action will be required to improve the behaviour of existing drivers. As is the case with adult cyclists, most drivers believe that they perform well and they do not contribute to the problem. Thus the first task will therefore be to inform people precisely of what the problem is. Advertising will often be the most effective method of communication, though the difficulties associated with trying to permanently modify peoples' behaviour should not be underestimated. This task will require a great deal of time and resources. Additional methods of reinforcing this message could include the distribution of posters and leaflets at gas stations, car parks and auto shops and the inclusion of leaflets with all official mail connected with motor vehicles, such as driving licence and vehicle insurance renewals. Furthermore, the 4 588 drivers who were suspended in 1986 must attend a reinstatement interview to reapply for a licence, this practice continues each year and it is in situations like this that information on bicycle safety could be provided to this type of applicant. Fleet truck drivers, bus drivers and drivers of public utility vehicles are an easier audience to reach. Speakers could disseminate information at meeting places or it could be included with company circulars.

The objective is to improve motorists' understanding of their (and bicyclists) rights and responsibilities in a shared roadway environment. This would be facilitated by:

i Working with the Division of Driver Licencing to include bicycle-related questions on drivers licence examinations,

[1] Gary Anderson, Chief Instructor Winnipeg Transit, 14 September 1988.

ii Encourage the inclusion of bicycle segments in driver education programs and repeat offenders programs. As well as more detailed information on bicycling included in the *Driver's Handbook,*

iii Prepare a series of concise handouts that target key education/awareness issues related to bicycles in the public right-of-way for widespread distribution to motorists.

iv Prepare and promote training courses for professional drivers that alert them to the special problems of bicyclists and provides skills to handle this new element of traffic.

Encouragement

The importance of publicity and promotion is badly underestimated by many authorities. To be successful the effort put into publicizing a bicycle initiative must be fairly substantial. There are two main types of publicity work, each with its own goals. Regular reporting should keep the public informed about the development of plans in the area, while special campaigns should attempt to focus public attention on a particular event or issue (e.g., the opening of a new cycle route, or childrens road safety program).

The key to a successful strategy is employing as wide a variety of tactics as possible, thus creating a sufficient impetus to generate widespread interest within the community. Minimal resources can be stretched to their utmost by working with cyclists, bicycle retail shops and manufacturers and anyone else involved in the bicycle plan who can offer useful resources, such as teachers and police officers. Many of the following methods may be utilized to help make the subject an important issue: the media (television, radio and newspapers), leaflets and posters, competitions, exhibitions, public speaking and newsletters.

Enforcement

For many years measures to ensure cyclists to obey the rules of the road have been lax. Each year this has been met with the usually response from the city police, they announce a crackdown on all cyclists who fail to adhere to these rules. Selkirk RCMP, in response to the proliferation of complaints by motorists, have initiated a program of prosecuting all cyclists who do not obey these rules. Fines for bike infractions include: a $33 charge levied for a series of offences, like; riding on the sidewalk, failing to signal for turns, carrying a passenger, failing to ride in single file, and riding without a light at night, a $40 charge is levied for; riding with a walkman on and failing to ride in the designated

bike lane on Henderson Highway.[1] In Winnipeg a cyclist found guilty of riding a bicycle on the sidewalk can be fined a minimum of $50 dollars to a maximum of $1000 dollars. A bylaw is also available that allows city police to seize a bicycle because of traffic violations. In addition, if a cyclist is convicted of an infraction under the Highway Traffic Act within the province and possesses a vehicle drivers licence, he/she may have demerit points added. Unfortunately this is merely an attempt to placate those opposed to cyclists, because the polices' enthusiasm quickly dissipates and, as a result, cyclists have taken the liberty of doing as they please. This problem has been compounded by inappropriate traffic management measures which discriminate against cyclists by placing them in an inferior position to motorists. Therefore, it comes as no surprise when the laws are not adhered to by a significant proportion of the cycling population.

The opposite side of the enforcement issue is the inconsiderate behaviour of many motor vehicle drivers, who treat cyclists as second-class road users, although it should be acknowledged that this is partly due to some cyclists flagrant abuse of the laws. The effect of these often strongly held attitudes is that cyclists feel that poor motorist behaviour should be punished more harshly and more often, and motorists believe that good behaviour by cyclists should be more rigorously enforced. The net result is that if either party is apprehended for bad behaviour they feel victimized. Statistics indicate that a successful program is urgently needed. In Calgary, the city police, as of the end of May, recorded 375 confrontations between cyclists and motorists. Most are just shouting matches, but in one incident a vehicle passenger gained control of the car and ran down the cyclist after he had been beaten by the car driver with a baseball bat. The police attribute the rise in numbers to three causes, the heavier traffic loads in the downtown where car and bike come into more frequent contact, on bike paths where cyclists travel too quickly and to motorists who don't view bicycles as vehicles and as such, aren't prepared to give them any space on the road.[2] A pre-requisite for any enforcement program is therefore an understanding, by both groups, that most roads have to be shared and that an acceptable common code of behaviour is in everyone's best interest.

Most of the work on enforcement measures has been carried out in the U.S.A., where it became a significant issue following the rapid rise in bicycle use in the 1970s. However, there was a curtailment in the number of enforcement schemes before conclusive

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[1] *Selkirk Enterprise*, 29 June 1988, p.1.
[2] *Alberta Report*, 30 May 1988, p.35.

evaluations could be formulated. Thus it is only possible to make tentative conclusions about the potential of different measures, although a number of discoveries were made. Firstly, education and enforcement are inextricably linked; on the one hand, it is practically impossible to enforce measures without the support of a good education program, and on the other, education has been found to need the support of enforcement measures to change people's behaviour. Secondly, in many communities there is little concern about the accident problem and therefore no desire to see that behaviour improved. Communities therefore have to be made aware of the seriousness of the bicycle safety problem and the reasons why measures have to be taken to combat it, prior to the program's implementation. A number of enforcement programs (e.g., roadside ALERT test, seat belt laws, etc.) have found that success depended on extensive media coverage and enforcement schemes. This leads to support from the community for the program, which in turn makes police officers feel justified in their actions. Thirdly, the enforcement authority must give reasonable priority to the enforcement program to ensure its success. In particular, the provision of a regular budget is the best singular effective way of assuring the success of a program.

Responsibility for enforcement measures will fall primarily on the police force, so their involvement and enthusiasm is essential for the entire bicycle program to be successful. One of the most successful methods for achieving this has been to allocate specific responsibility for bicycle work to one person, a bicycle coordinator. However, it may well be that the planning or transportation department has to take responsibility for motivating interest within the police department in the first place. Fourthly, in-service training is essential. Highly trained police officers consider reprimanding bicycle offenders as an insignificant function. A refresher seminar is perhaps required to make officers aware of the problem and the issues. Finally, the continuing success of the program depends on support from senior officers and regular reminders by them of the value of the program. The range of measures available will vary depending on the legal framework and their political acceptability. The costs should remain low, since the main resource required for such a program is the time of police officers.

Measures for Cyclists

Since cycling accidents are more prevalent in the younger age groups, enforcement will often concentrate on this group. The measures employed by other municipalities include: verbal warnings to the offender; warnings to the parents; and, laying charges.

Measures for Adult Cyclists

Similar to the youth, an adult cyclist may receive a verbal warning or have charges laid, but too often the former is too weak and the latter too strong, for the average offence. Some communities have begun experimenting with tickets specially designed for cycling offences, called Traffic Infringement Notices. The cyclist is issued a ticket which describes the offence and is followed by a caution notice which is sent to the offender. If the offence is repeated, the police, at their discretion, may issue another warning or prosecute the cyclist. Appropriate punishment may include; a small fine, mandatory attendance at safety classes or the impounding of the bicycle for some period of time. In Ontario a cyclist is considered to be operating a vehicle as described in the Ontario Highway Traffic Act. He/she therefore has to obey the same rules of the road as would a motorist. Currently though, if the cyclist commits an offence, he/she is *not* required to provide the police officer with their proper name and address as they are not required to possess a driver's licence. As such it is very difficult to ticket them.[1]

Measures for Motor Vehicle Drivers

There are currently many procedures in place to facilitate the prosecution of motorists who commit traffic offences. Ticketing is used to enforce good behaviour. However, the problem of ensuring that motorists do not infringe on the rights of cyclists is three-fold: firstly, many police forces are understaffed and time is better spent on more serious crimes. In Winnipeg, there are, on average, 34 black and white police cars patrolling the city streets during a regular shift. Secondly, many police officers are unaware of the problem because in some cases they hold the motorists' view that cyclists just get in their way , and lastly, the police may consider it a waste of their time. Perhaps the best method for an officer to learn about the problem is to use a bicycle for a period of time. There are various police forces across the United States that employ a somewhat more positive approach to the problem. In New Jersey the police attend an annual briefing on bicycle enforcement and the patrol cars are equipped with bicycle racks for impounding bicycles that are stolen, unregistered or have serious mechanical defects. Police forces in some Canadian cities have taken this a step further by placing some of their inner city patrols on bicycles. Windsor, Ontario is the most recent city to experiment with the new mode of transport.

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[1] J. Douglas Cowan, Senior Information Officer, Ontario Ministry of Transportation, September 1988. The Ministry is hoping to have legislation in place before the Spring 1989 that would make it mandatory for all cyclists stopped by the police to correctly identify themselves.

It is important that both motorists and cyclists receive effective enforcement to improve their behaviour. But moreso for the car driver. As indicated previously, a recent study of car/bike collisions in Toronto, found motorists to be at fault in 60% of the cases and cyclists 40%.

3.64 Licencing Cyclists

The major benefit of requiring cyclists to hold a licence is that they can be tested on the rules of the road and proficiency in using a bicycle before taking to the streets. However, the cost of organizing such a system and the problem of "foreign" cyclists would seem to outweigh the benefits. Alternatives to this type of city-wide licencing scheme that have been experimented with elsewhere includes: requiring all children under the age of 14 to pass a proficiency test before cycling on the roads; having the school teacher approve a child's route and discuss the rules and responsibilities before being permitted to cycle to school and prohibiting all un-trained cyclists from using the city's main arterial streets.

3.65 Bicycle Registration

The primary aim of a registration scheme is to discourage theft and assist in the recovery of stolen bicycles. In 1987 Winnipeggers endured over 5 300 bicycles stolen (although the figure may be higher because some owners are able to recover their bike on their own and thus never report them as stolen). Of these, Winnipeg police recovered 1 466 and of those, returned 212 to their rightful owners mainly through the use of serial numbers. But registration can also be used to improve the mechanical standards of machines on the road, and as a means of identifying riders who give false names and addresses when issued with warnings.

A simple system requires that bicycle frames be stamped with a serial number that is recorded locally against the owners' name and address. If a renewable licence system is used, then a sticker is required in addition to the frame number to indicate that the licence has been renewed. Fees varying from $1 to $5 for a two-year licence have been charged by various cities and riding a bicycle without a licence is made an offence.

The year 1982 marked the last year that Winnipeg registered bicycles. In 1981 there was 50 211 licences issued which resulted in $99 980 dollars of revenue being generated, however, this was down significantly from the 68 289 licences issued in 1974. The city formed an ad-hoc committee in the summer of 1982 to study the question of bicycle registration. The committee studied other cities across the country and found that

most were in the process of phasing registration out, they also entertained public presentations where people indicated that there was no longer a need for registration and the committee discovered that few people were actually concerned with the return of their stolen bike (the premise on which bike registration was based) because they were reimbursed by their insurance. Thus the committee recommended eliminating the requirement for bicycle registration and council adopted it. The problem of stolen bikes has proliferated in recent years, it has now reached the point where one police officer is employed full-time and whose sole responsibility is the recovery of such bikes. To dispose of the litany of unclaimed bikes, the city holds two auctions a year. In 1986 the sales of bikes raised $44 083 dollars for the city and this trend is showing no signs of abating as almost 1 200 bikes were auctioned off in 1987.[1] The Selkirk RCMP have initiated a bicycle identification campaign in response to the over $20 000 dollars in bicycles stolen last year in Selkirk. The reduced cost is now $1.50 to cover the cost of a small metal licence and processing the information. Bicycle licences had been available in Selkirk every year, but this service was stopped once Winnipeg discontinued the practice.

The goal of encouraging effective enforcement of bicycle-related laws to improve bicyclist and motorist behaviour may be accomplished through the following projects.

- Explore means of supplementing the enforcement activities of the city police with trained officers.

- Provide frequent briefings to the police on bicycle enforcement.

- Target enforcement activities toward specific cyclist and motorist behaviour that is the likely cause, or will increase the severity of a traffic accident and thus create high levels of disrespect between motorists and bicyclists.

- Provide a special focus on high accident areas and in areas with concentrations of bicyclists most often involved in accidents (e.g., near schools, the downtown, etc.).

- Evaluate the possible options for adjudication of bicycle offences such as the issuance of warning tickets, fines, conducting bicycle law violator's seminars, requiring completion of on-bicycle training programs and establishing a "peer court" for hearing and sentencing violators.

- Reduce bicycle thefts by disseminating information on effective ways to secure bicycles and provide high-quality bicycle racks.

- Review and evaluate enforcement programs from other areas for possible

[1] Chuck Mala, Chief Accountant, Winnipeg Licence Branch, July 1988.

application in Winnipeg.

The bicycle master plan for Winnipeg should incorporate the design criteria guidelines outlined in this chapter where possible. Experience has shown that appropriately designed and located bicycle facilities will be high in demand. An efficient and balanced cycling network will help to alleviate the high incidence of cycling accidents in the province. Chapter Four examines the cycling developments in four North American cities. Each of these communities employ a four E approach to bike planning, (proper Engineering, Education, Enforcement and Encouragement) that has been outlined in this chapter.

CHAPTER FOUR
CASE STUDIES: COMMUNITIES RESPOND to the BICYCLE

Mention the word *Bicycling* and one invariably thinks of two cities in the United States that are both unique and unparalleled in their approach to this alternate mode of transport. Eugene, Oregon and Davis, California have become synonymous with bicycling. Canada, with a climate that can be at times, less than compatible with bicycling, has produced several notable examples of bicycle cities. This chapter explores the bicycling developments in Ottawa, Ontario; Edmonton, Alberta; and Vancouver, British Columbia; in addition to Eugene, Oregon. The evaluation will examine the current state of development in these cities as well as an exploration into the future of cycling in these municipalities'. The Canadian cities have recently conducted an evaluation of the bicycle facility development within their communities. These studies have provided a bevy of recommendations for the improvement of their programs, but a number of them may be applied to the situation in Winnipeg. Therefore, within each of the sections documenting the three cities, the recommendations applicable to Winnipeg have been duly noted. The fourth city, Eugene has been included for its unique approach to the bicycle. All four communities provide useful insight on the developments of bikeway planning, from its conception to its fruition, providing valuable lessons and direction for Winnipeg

4.1 OTTAWA, ONTARIO

Canada's National Capital is built at the junction of four waterways; the Ottawa, Rideau and Gatineau Rivers and the historic Rideau Canal. It is these waterways which have, to a large extent, determined Ottawa's park development over the years. The present pathway system makes extensive use of the open space and parkland adjacent to the waterways.

The planning of Canada's Capital was first initiated in 1899 with the creation of the Ottawa Improvement Commission. Its first priority was to clean up the river banks of the Rideau Canal and establish parks, open spaces and scenic drives in Ottawa and Hull, Quebec. In 1927 the OIC was replaced by the Federal District Commission which was given broader powers and an enhanced budget. The majority of the planning undertaken by the Federal District Commission and the National Capital Commission[1] was the

[1] The National Capital Commission was created in 1959.

responsibility of renowned town planner, Jacques Greber. Greber was invited to Ottawa to assist in the planning of the city, which eventually resulted in Greber formulating a master plan for Ottawa. The Greber plan was finalized in 1951. To date, most of the Plan's recommendations have been implemented, including the development of a greenbelt around the City of Ottawa, the relocation of railway lines in the region, the expansion of Gatineau Park, the decentralization of government office complexes and further development of parks and green spaces throughout the urban area.

The progress made by the late 1950s provided the opportunity for a recreational pathway system to be developed. By the 1960s a region-wide open space and parkland network was in place, using the waterways, parkways, greenbelt and large park areas. By incorporating the pathways into this open space and parkland network, visitors and residents are able to obtain new insight and opportunities for enjoyment of the National Capital region. The unique environmental and cultural resources of the region are now more available due to the extensive development of the recreational pathways network.

Since 1959 the National Capital Commission has constantly updated the Greber Plan and developed other proposals to display the beauty and the diversity of the region. For example, residents of the Capital enjoy designated roadways that are free of motor vehicles on summer Sunday mornings. During these times they are reserved for the benefit of cyclists, joggers and walkers. Totaling more than 100 kilometres, the NCC pathways connect major recreational centres, scenic features, Gatineau Park and the greenbelt - to residential and urban areas. These links provide a network of loop routes and various destination points. The pathways provide views of the Capital's scenic beauty, both natural and man-made. Pathways are used during all seasons for a variety of recreational pastimes and for commuting. They are open to everyone including pedestrians, cyclists, roller skaters, skate boarders and the handicapped. Activities vary from summer festivals to winter jogging.

4.11 1970 to 1973

The development of Ottawa's recreational pathway system can be delineated into three main construction periods. The first is 1970 to 1973. During this time period, better facilities for biking were demanded and planners looked to the network of open-space and parkways. There was little non-motorized use of the linear open-space system until 1970 when the Commission began placing greater emphasis on recreational use of its lands.

That year a program was launched to build scenic bikeways; four years later the first 40 kilometres of the region's pathway system was completed.

4.12 1974 to 1982

This period of development witnessed the fitness and bicycle boom. This new trend quickly overloaded the 40 kilometre system. Thus, there was a distinctly different emphasis than what had occurred over the first phase. The main thrust from 1974 to 1982 was the upgrading and widening of the paths to cope with the tremendous popularity they garnered. During this period the notion of exclusive bicycle paths was dropped in favour of wider, multi-use recreational pathways. However, many of the pathways built previously were originally designed as pedestrian walkways. Thus some modifications were necessary. Some paths were widened and upgraded, pedestrian underpasses were added and various roads and bridge improvements were undertaken throughout the network. In addition to the rehabilitation of some paths, a total of 25 kilometres of new paths were constructed. This period marked the involvement of local municipalities and planning agencies that surround the National Capital region. They began their own pathway systems, frequently making use of the road edges and on occasion, the parks. These routes linked into the NCC pathways whenever convenient. The result is an intense network of pathways that allows a cyclist to journey throughout the region, exclusive of the street system.

4.13 1983 to 1990

By the year 1985, 100 kilometres of recreational routes had been completed. By 1990 it is estimated that there will be about 150 kilometres of National Capital Commission recreational pathways. This figure excludes the region's local municipality pathway system. A 35 kilometre path connects the NCC greenbelt surrounding Ottawa with the outlying communities of Kanata, Nepean, Rockcliffe Park, Vanier, Gloucester and Orleans.

Pathway routes can also be found on the Quebec side of the Capital. The paths in, and around Hull, form a continuous route of approximately 25 kilometres along the Gatineau and Ottawa rivers. This route also connects to the very popular Gatineau Park pathway and to the network located on the Ottawa side of the National Capital Region via a combination of vehicular and pedestrian bridges.

4.14 Recreational Pathway Classification

The common practice is towards wider and multi-use pathways to accommodate the increased demand by the various user groups. Where space is available, a minimum standard width of 3 metres has been instituted to handle the volume and improve safety levels. The Commission utilizes the following four categories of pathways:

Category I: Designed for the exclusive use of bicycles, with separate pedestrian paths or sidewalks located nearby.

Category II: The paths are a combination walkway and bicycle route and the basic standard is a minimum 3 metres wide. They are located on Commission lands.

Category III: This type is a combination parkway and bicycle path. Parkways with a legal speed limit of 60 km/h or less are considered to be safe for the shared use by cars and bicycles. Sufficient pavement width is allowed for 1 metre marked bicycle lanes at the sides of normal width, traffic lanes. This type of pathway is preferred by commuting and sport riders, especially since other nearby pathways are commonly used by the slower speed recreational cyclists and pedestrians.

Category IV: These are combination street and bicycle paths. Local or collector streets with a legal speed limit of 50 km/h or less are used. The cyclists' and motorists' lanes are clearly painted on the roadway and suitably signed. Arterial roads with a high volume of traffic are avoided. This type of pathway is commonly used by the National Capital Commission recreational pathways wherever convenient.

4.15 Recreational Pathway Improvement Program

In 1984/85 the National Capital Commission noticed an increasing number of complaints from the public concerning accidents or near accidents, between pedestrians and cyclists, occurring on certain pathways. In response to these complaints the NCC commissioned a study to investigate the allegations.

The primary problem was found to be a conflict in use between cyclists and other pathway users, but primarily pedestrians. Attributed largely to the increasing popularity of the recreational pathways, their use has flourished to a level where frequent confrontations between the various user groups occur. The most commonly cited hazardous situation is that of the cyclists approaching pedestrians from the rear at high speeds. Because modern bicycles are so fast and quiet, cyclists are often undetectable until they are very close to the pedestrian. The reaction of the pedestrian is to move aside suddenly, sometimes into the path of the cyclist, who due to his/her speed is unable to avoid a collision.

4.16 Solution Recommendations

A number of potential solutions to the problems of user conflict were derived from the Ottawa study. The 11 proposed here range from the re-design of site factors to policy matters.

1 Pathways in all areas where there is a high potential for user conflict should be widened and divided into lanes. The study recommended a minimum width of 4 metres, with 1.5m allocated to pedestrians and 2.5m allocated to 2-way cyclist traffic. In areas where pathways cannot be widened due to physical limitations, time or fiscal constraints, laneway delineation should be marked and hazard signs posted. Painted symbols on the pavement or textured pavements could be used to heighten user awareness of hazardous situations.

2 Because many of the recreational pathways are modified "bicycle paths" there is some confusion surrounding who the rightful users of the pathways are. The result is many cyclists view pedestrians as nuisances and are trespassing on their trails. Therefore signs clearly indicating the right-of-use for both pedestrians and cyclists should be posted. As well, the rules of pathway use should be prominently displayed. The signs should be few in number and uncomplicated so as to be easily understood and remembered.

3 The current demand may vary from one user group to the next, but it is not expected to diminish in the future. A major group which will warrant additional attention in the future is the growing senior citizens and handicapped population. Wheelchairs and 3-wheeled cycles are increasing in numbers and will have to be planned for.

4 Bylaws governing recreational pathway use could be passed by the NCC to improve policing potential. Students may perhaps be given the status of bylaw control officers and could be used to patrol the pathways, this would provide a strong influence encouraging the adherence of the pathway rules. The NCC's student recreational pathway patrol that was in place two years ago had proved to be of considerable value. This role would be expanded to provide advice, information and emergency assistance (mechanical and first aid) to pathway users.

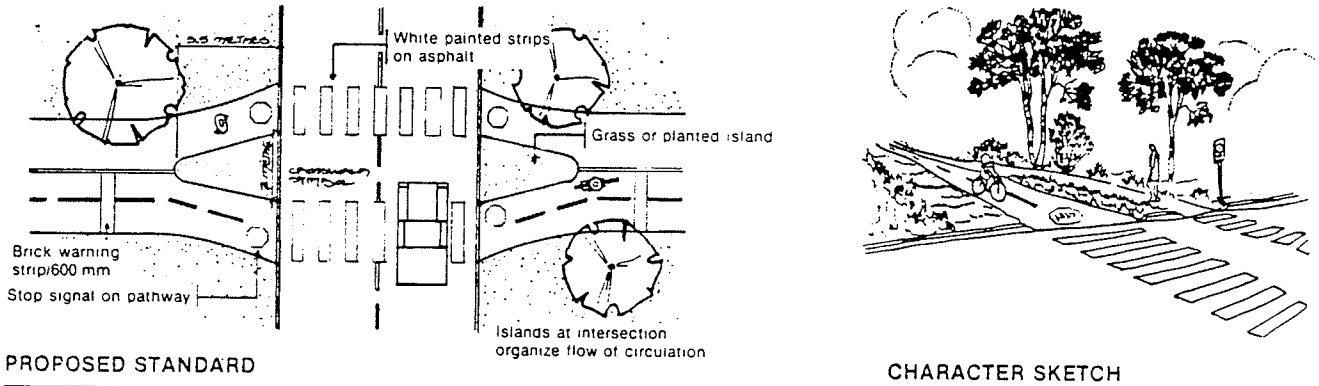
5 Currently cyclists are not included under the provisions of the Ontario Motor Vehicle Act and as such, they do not have to identify themselves when requested to do so, and therefore cannot be charged by police for infractions. Thus the Ontario Motor Vehicle act should be amended to include cyclists so that the police can charge those who threaten the safety of others and who do not adhere to the law, both on recreational pathways and on roadways. Although this should soon be rectified as the Ontario Minister of Transportation has recently announced that legislation is being tabled that will include cyclists under the Provincial Motor Traffic Act. (In Manitoba cyclists are included under the provisions of the Highway Traffic Act and can be charged).

6 A large portion of cyclist/pedestrian conflict can be overcome if users develop attitudes of respect and consideration for each other and this can only be achieved through an educational approach. Therefore the NCC should promote the safe use of all recreational pathways through the use of displays and signs located along pathways, through the use of pamphlets distributed at pathway access points, at schools and at the workplace, through media advertising and through promotional events. This, combined with other measures outlined, will bring about a significant improvement in the safety of pathway use. Until full policing power can be provided, the educational aspect will be of paramount importance and will always be a significant component in achieving safe pathway use.

7 The pathways have been designed for the recreational pursuits of a variety of users, and cyclists travelling at high speeds are not compatible with these recreational goals. Thus cyclists who are primarily interested in commuting or in speed training should be encouraged to use the roadways, streets and parkways. To facilitate this, conditions for cycling must be improved, for example, provide comfortably wide cycle lanes, remove catch basins from pavement areas to a recessed position in the street curb and designating centre-of-road left turn lanes for cyclists.

8 At the intersection of pathways and major roadways, there is the potential for safety problems for both pedestrians and cyclists. To heighten the awareness of pedestrians and cyclists at intersections certain features can be added or improved. These include a change of pavement materials, painted crosswalks and intersection islands planted with vegetation that would be incorporated to direct pathway circulation. (See Figure 34).

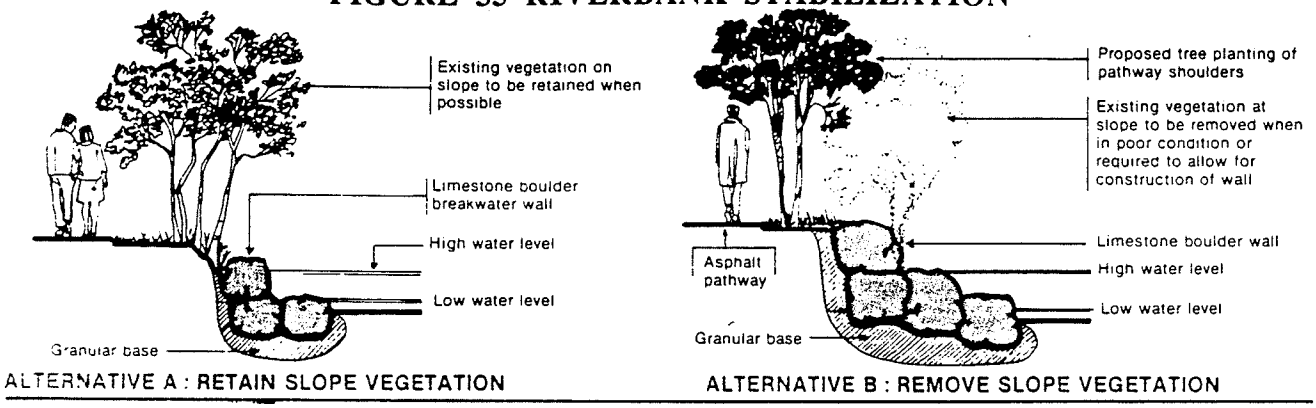
FIGURE 34 INTERSECTION MODIFICATIONS



Source: National Capital Commission, *Recreational Pathways in the National Capital Region*, p.85.

9 Since the initial construction of pathways along the riverbanks, erosion and spring flooding has been of significant concern. As a result of such erosion problems and consequent land slippage, certain stretches of the pathway system have become hazardous. Therefore for economic and safety reasons, shoreline erosion control be implemented in conjunction with pathway construction. In addition, whenever possible, the natural features and visual quality of the shoreline be reflected in the construction of the breakwaters. (See Figure 35).

FIGURE 35 RIVERBANK STABILIZATION

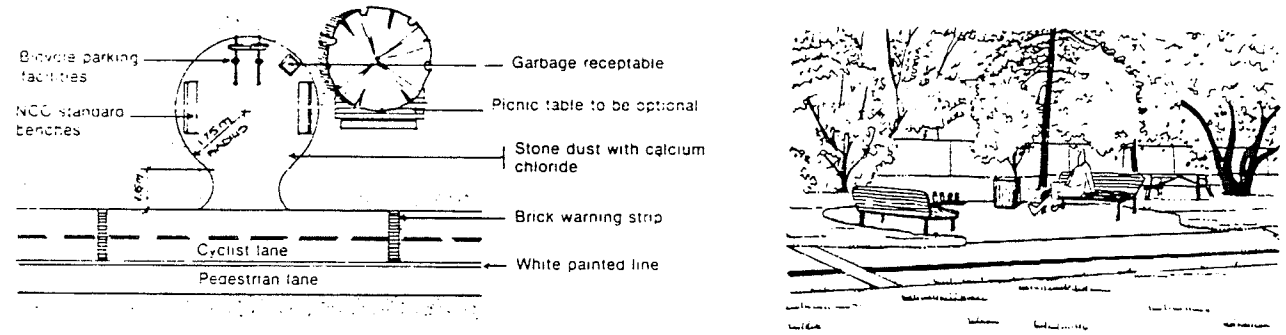


Source: National Capital Commission, *Recreational Pathways in the National Capital Region,* p.89.

10 Numerous conflicts have arisen due to users not being clearly aware of the intended use limitations of the pathways. This has contributed to numerous conflicts between cyclists and pedestrians. Thus signage be developed to ensure that users are made clearly aware of the intent of each pathway type, their respective features and the rights and obligations of each user. Also, directional signage is to be provided at all major intersections to avoid confusion as to pathway destinations.

11 Users have indicated that benches are located too close to the travelled pathway surface, especially in high use areas. A new concept would be implemented to have the seating set back from the pathway, providing users with more comfortable seating opportunities and reduce the possible conflict between active and passive users, resulting in a more constant and a safer traffic flow. (See Figure 36).

FIGURE 36 REST STATIONS



Source: National Capital Commission, *Recreational Pathways in the National Capital Region*, p.89.

The City of Ottawa is fortunate to have the National Capital Commission involved in the planing, construction and maintenance of the many bicycle paths that traverse the

National Capital area through the open space corridors. But recently there has been a shift in the NCC's mandate which has devolved responsibility for the construction and maintenance of bicycle paths to the municipalities. For this reason Ottawa has proposed an Official Plan that has identified goals, objectives and policies for an efficient bicycle network throughout the city.

Ottawa's Official Plan establishes the goal of encouraging the integration of a comprehensive network for pedestrians and bicycles into the overall transportation system. The Plan acknowledges that by providing good accessibility to shops and employment areas for both pedestrians and cyclists, it will reduce the city's dependency on the private automobile. As well, community services that are readily accessible can encourage seniors and persons with restrictions in mobility to live in their neighbourhood longer, thereby increasing community stability. To accomplish this goal and minimize the cost to the city, Ottawa has initiated a program of granting incentives to the development industry if they undertake the creation of desired pathway facilities as described in the Plan. The infrastructure that is eligible under this initiative includes; providing bicycle parking facilities and sidewalks/pathways in all new developments or redevelopments, that will integrate with the City's pathway network. The guiding objective is to provide a bicycle network that serves both the leisure and utilitarian bicycle user. Planning agencies in Ottawa-Carleton have been assisted in all facets of bicycle planning by the organization, Citizens for Safe Cycling. It is a non-profit association that promotes safe and efficient cycling in the region.

4.2 VANCOUVER, BRITISH COLUMBIA

A hilly topography and rainy climate are two environmental conditions that most cyclists would prefer to avoid. However these two attributes of Vancouver have failed to dampen any cyclist enthusiasm. The popularity of cycling has steadily increased over the years. Currently there are over 47 000 bicycle trips made on an average weekday. This resurgence of bicycling accounts for over 2.3% of all vehicle trips recorded in the city. This increase has generally been attributed to the publics' increasing awareness of cycling as an effective, enjoyable and inexpensive means of transportation.

With this growth it became necessary to formulate a bicycle plan that would be structured to meet Vancouver's present needs and anticipated future demands. This task was undertaken by the city's engineering department. Statistical information on the city

cyclists was gleaned from the *1985 Greater Vancouver Regional District (GVRD) Origin/Destination Survey* and the 1987 Vancouver Bicycle Survey. In June 1988 a draft of the *Vancouver Comprehensive Bicycle Plan* was completed. It contained an inventory of the current cycling facilities, an evaluation of bicycle developments in other North American cities, and formulates recommendations for Vancouver on all aspects of cycling.

Vancouver first foray into the provision of bicycling facilities is the 8.0 km Stanley Park Seawall Walk/Cycle Path. The cycle route is separated from the pedestrian walkway be means of a painted line and in some cases by grade separation. This route is enclosed entirely within the park and therefore has no cross traffic to contend with, but being within walking distance of the downtown, it does experience very high pedestrian volumes. As such it leads to number of inevitable cyclist/pedestrian conflicts. The second major segregated bicycle path is the B.C. Parkway or 7-Eleven Bicycle Trail. Completed in 1986, this route parallels the new automated light rail transit line, which runs from the New Westminster waterfront to False Creek in the downtown. During the design and construction phase there were numerous problems encountered. Most were anticipated as conflicts can be expected when trying to integrate a 21 km recreational pathway through residential lands and a heavily used transportation network. Busy intersections, arterials and high volume pedestrian areas made it impossible to ameliorate all cyclist/motorist and cyclist/pedestrian problems. However the resulting 7-Eleven bicycle trail connects 32 municipal parks providing a highly scenic route for the traffic-conscious recreational cyclist.

Another successful bicycle facility is the Habitat Bicycle Route established in 1976. This is a signed, on-street recreational bicycle route which extends from the existing Seawall Cycle route in Stanley Park to the University of British Columbia. Future development that is planned for False Creek would allow for a continual seawall link to the B.C. Parkway 7-Eleven Trail. This would provide a continuous recreational bicycle facility link from Stanley Park to New Westminster. The bicycle plan proposes the development of segregated recreational routes in certain areas, that are attainable at a minimal cost to the city. These include: the use of lands made available within Vancouver through the abandonment of rail lines, which are ideally suited to cycling because they are isolated from other traffic, are flat and are not located in heavy use pedestrian areas; along ocean and river foreshores, particularly suited because of the paucity of cross-traffic and the heavy use by pedestrians in the summer months; and highway rights-of-ways, which would include the construction of a parallel bicycle facility as a beautification project that

would enhance the livability of the area while providing direct and convenient access for cyclists.

In addition to simply providing the necessary physical infrastructure for cycling, the city encourages cycling through its support of various cycling events. These include wheelathons and the "Bike to Work Day" or "Working Wheels", initiated by the Canadian Cycling Association in 1987. Working wheels is a one-day encouragement campaign to all employees to use their bicycle to commute to work. The city has also continued Bicycle Sundays which was originally established in 1969 to promote cycling as a family event. This project has proved to be very popular among the city cyclists. The event had been held in Stanley Park up until recent years when it was relocated to the False Creek area.

The recently completed Vancouver Comprehensive Bicycle Plan embodies four fundamental elements to achieve a successful cycling program. The city's primary goal is to safely integrate the cyclist into the transportation network and the acceptance of the bicycle as a safe and convenient mode of transportation.

i ENGINEERING
ii EDUCATION
iii ENFORCEMENT
iv ENCOURAGEMENT

These are commonly referred to as the four E's of cycling. They are interdependent, that is, no plan will be successful unless it is fully committed to each of these four fundamental areas.

4.21 Engineering

The engineering component of a successful and comprehensive bicycle plan is the foundation on which the entire plan is predicated. The essential facilities which the cyclist requires can be provided through proper cycling transportation engineering. Proper education, enforcement and encouragement can only proceed once a strong engineering commitment has been established. In summary, the cyclist requires two basic facilities, these are:

1 Direct, convenient and safe access to the destination.
2 End of trip facilities.

An analysis of numerous North American cities prompted the engineering department to conclude that only the integration of the cyclist onto the roadway is shown to be the most

successful. Segregating cyclists by implementing pathways was proven to present the following disadvantages:

- Give the cyclist a false sense of security (over-confidence) resulting in less cautious traffic behaviour and a lower awareness of the traffic situation.
- Place the cyclist in unexpected positions, especially at intersections and mid-block driveways.
- Encourage wrong way riding, placing cyclists in more unexpected locations for motorists and other cyclists.
- Increase difficulty for motorists in negotiating turns at the intersections by adding to the turning arc.
- Require excessive right-of-way (disproportionate share of the street).

As a result, bicycle accidents have been shown to increase by 2.5 times where separated bike lanes have been introduced.[1]

Whereas the integration of the cyclist onto the roadway promotes the bicycle as a vehicle. Only through shared use of the existing roadways can the cyclist obtain widespread acceptance by the motorist. The engineering department can ensure proper integration of cyclists onto the roadway by planning for all road users, including cyclists, in the initial design of the roadway. Recommended provisions for the cycling component of traffic include sufficient lane width, improved signage, hazard location/elimination and proper location/configuration of on-street utilities, barriers, etc. Lessons and Recommendations from the Vancouver study include:

1 That a street priority system for cycling be undertaken as a system to determine where bicycle requirements should be considered in road design and future improvement projects. This was based on the:
- identification of existing usage levels on all streets;
- location of major trip generators;
- analysis of reported bicycle/motor vehicle accidents and locations.

(Vancouver created three levels of priorities for its street system.)

2 That the City of Vancouver engineering department road design standards incorporate recommended lane widths, where practical. A minimum of 3.6

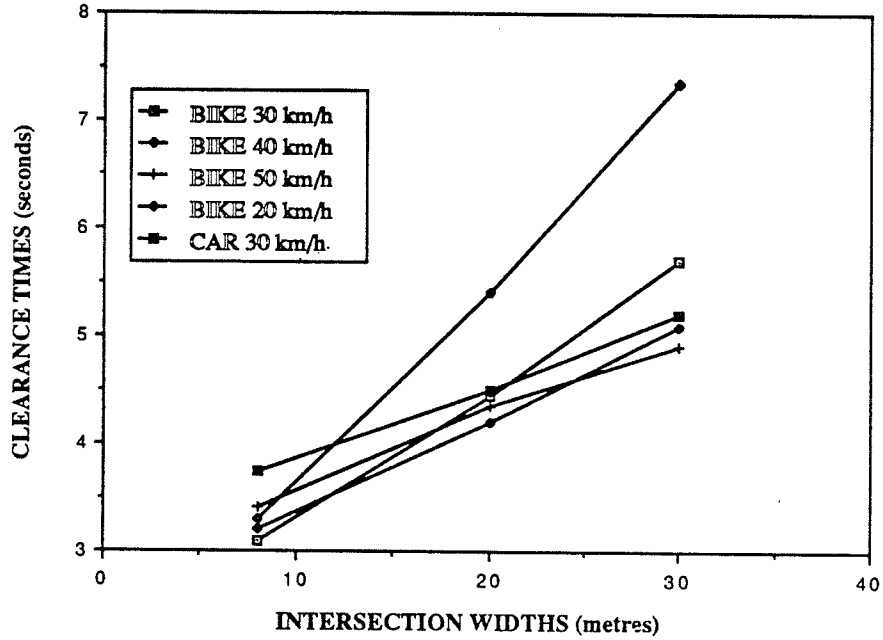
[1] John Forester, *Effective Cycling*, 1986.

metres is proposed for the curb lane width. The wider outside lanes have the following benefits:

- motorists are able to overtake cyclists more safely;
- eliminate motorist delay;
- reduce tension between motorists and cyclists;
- increase the attractiveness of cycling through increased safety;
- increased manoeuverability for trucks and buses.

3 That, where practical, all future interval clearance time calculations for signal installation utilize calculated bicycle intersection clearance times in cases where they exceed that of a motor vehicle. (See Figure 37).

FIGURE 37 INTERSECTION CLEARANCE TIMES



Source: Vancouver Engineering Department, *Vancouver Comprehensive Bicycle Plan*, p.49.
Figure 37 illustrates the required times for a bicycle exceeds that of a motor vehicle at an intersection width of 14 m for a 20 km/h bicycle approach velocity and 22 m for a 30 km/h bicycle approach velocity. The 20 km/h bicycle approach velocity would not apply to cyclists on non-arterial residential streets. Cyclists are generally not able to obtain a greater velocity on residential streets due to the many frequent stops required at stop signs and equal intersections. The 30 km/h bicycle approach velocity would apply to cyclists on major arterial streets. The cyclist is able to maintain a higher velocity on major arterial due to the fewer interruptions and increased riding intervals.

4 That all future roadway projects be designed to include cyclists. In situations where such access is unsafe, that an alternate safe, direct and convenient bicycle facility be provided, if practical.

5 That the City of Vancouver consider incorporating minimum bicycle parking requirements into the Vancouver Parking By-Law for all new developments.

6 That the Engineering department and Planning department continue to pursue minimum recommended bicycle parking in all new developments at the

development permit stage, using the floor space ratio exemption as an incentive.

7 That facilities for recreational cyclists be progressively provided, wherever practical, along railway reserves, ocean and river foreshores and highway right-of-ways.

4.22 Education

The education of the general public plays a vital role in the success of a comprehensive bicycle plan. Only through education will the cyclist and the motorist safely share the roadways. Cyclists can greatly reduce the likelihood of being involved in an accident by increasing their traffic cycling and bicycle education skills through proper education. A successful bicycle education program must therefore have the objective of encouraging the use of helmets, lights, reflectors, safety vests, the need for a mechanically safe bicycle, and most importantly, the development of traffic skills. This program should reach all ages with priority given to high risk age groups. Each age group requires a unique program that will directly deal with cycling errors common to that group. Young children, school age children, adult cyclists and motorists, are all included as prime target groups in a successful comprehensive bicycle education program. Important ancillary groups include parents, teachers, motor vehicle instructors, police officers, engineers, planners and bicycle retailers.

There are a number of independent programs presently being taught to children and adults in Vancouver. These existing programs range from independent instruction to community or school based programs. Unfortunately the majority of the existing programs do not require any instructor qualifications to teach on-road classes. The bicycle plan proposes the expansion of responsibilities for the Vancouver Bicycle Advisory Committee. The central body's enhanced responsibilities would now include the monitoring and approval of all education programs taught in the city.

Young children do not have fully developed reflexes and peripheral vision and are therefore more likely to be in an accident. However, the majority of children in this age category are not exposed to heavy traffic conditions but rather ride in their own neighbourhood or in residential streets and sidewalks. Accordingly, the majority of child bicycle accidents occur near the child's home. Parents have the most important role in the initial development of cycling skills for these children, but unfortunately the majority of them lack the necessary information. Thus the Vancouver study recommends that:

1 An informational brochure be made available for parents of children under nine years of age. This brochure would be distributed through schools, community centres, police and retailers.

2 The Vancouver School Board should work with the Bicycle Education Advisory Committee to introduce a basic bicycle safety course for children under nine years of age, using the Canadian Cycling Association certified instructors.

School age children between the ages of 9 and 18 account for over 1/3 of all bicycle accidents in Vancouver. The accident rate increases with this group due to the increased exposure to heavy traffic conditions and the increasing trip length. In general, children in this category are becoming increasingly independent and the role of the parent often diminishes as the vital source of information. The school must therefore play a more prominent role in bicycle education. Education in this target group should focus on traffic skills. Additional recommendations include:

3 That a bicycle education course is introduced as a compulsory component of the primary school curriculum for grades 4 to 7.

4 That the Vancouver School Board introduce in-class bicycle education into existing high school courses.

Adult cyclists are perhaps the most difficult group to correspond with, as there are no common associations or clubs through which all adults can be reached. Although adult cyclists comprise the largest contingent of serious cyclist injuries, only a small percentage will seek out and attend bicycle education courses. This is due mainly to the fact that most adult cyclists consider themselves experienced road-users and that they don't require any further education. A successful education program must therefore reach all cyclists, including adults. The plan proposes that:

5 A brochure geared specifically to adults be made available for distribution through automobile associations, community centres and retailers.

6 The Vancouver Parks Board, community colleges and universities be encouraged to expand their present bicycle education program to include adult CCA Can-Bike courses at local community centres, shopping malls, campuses, etc.

The education of motorists is an integral facet if cyclists are to safely share the roadway. Many motorists are unaware that cyclists belong on the roadway. Even motorists who are aware of road sharing are generally unfamiliar with bicycle lane positioning and proper passing procedures. The motorists must be educated on the rights and responsibilities of cyclists. The most direct and efficient method is to incorporate

bicycle related material into driver training programs. Booklets provided to potential motorists and driver training courses should give serious consideration to cyclists. In addition, the driving test itself (both the written and on-road) should require the candidate to express knowledge of the rights and responsibilities of a cyclist. Such a program would be slow in penetrating all the motorists, but it would ensure that all new motorists are bicycle conscious. In order to reach the existing motorist, a city-wide program, similar to Toronto's *Bicycles Belong* program and Australia's *Be Aware of Bike Riders* program using the mass media and posters proved to be effective. Media education in this manner has an immediate impact and is effective. Recommendations include:

7 The introduction of a road sharing brochure geared towards motorists be made available outlining the rights and duties of the cyclist and the motorist on the roadway. And that this brochure be made available through public agencies and bicycle organizations.

8 That driver training booklets and courses be revised to present cyclists as an integral part of the road user environment outlining the rights and responsibilities of cyclists. And that the driving test itself be revised to test for such knowledge.

9 That a city-wide *Share the Road* media campaign be introduced. And that promotional material on this campaign include posters, T.V. and radio advertising.

4.23 Enforcement

The third vital component of a successful bicycle plan is enforcement. Without a strict enforcement program education efforts would be to no avail. Cyclists behaviour is unlikely to improve unless the information reaching the cyclist is reinforced through the enforcement of existing traffic laws and regulations governing cyclists. Greater than half of all Vancouver cyclists are under the age of 16. Thus the enforcement program must be structured to deal with violations made by children of various ages. Presently in Vancouver, bicycle enforcement has not been a high priority for the Police department. This is partly due to the dilemma of interpreting the minimum age of legal responsibility and partly due to manpower constraints. With the increasing number of bicycle accidents and an increase in public awareness of the problem, the plan proposes reconsidering bicycle enforcement as a higher priority. To utilize police manpower more efficiently, increased enforcement should be geared towards the prevention of accident-causing types of cyclist behaviour.

Since 1982 courier companies in Vancouver have been using couriers on bicycles in the city centre. They are quick, inexpensive and very effective in a congested downtown.

Most couriers are paid on a piece rate (or per delivery commission) which the companies believe motivates the cyclist courier to deliver as quickly as possible. The commission structure has led to shorter delivery times, taking priority over traffic safety. Bicycle couriers have become well known for their general disregard and violation of traffic laws and regulations. Infractions frequently committed include: riding on sidewalks; running red lights/stop signs; riding on crosswalks; illegal passing, etc. Such violations are a threat to pedestrian safety and promote motor vehicle accidents. With no means of identification, many of these violations go unreported. Thus the plan recommends:

1 That a Commercial Bicycle Operator Licencing Program, which includes trained couriers, photo identification, bicycle licence plates and punitive actions for violators, be implemented in order to control the bicycle couriers.

2 That the Vancouver Police department run a one week Bicycle Enforcement Campaign - where several officers would specifically enforce traffic laws and regulations governing cyclists in an attempt to heighten their awareness.

3 That an informational pamphlet, outlining cycling traffic laws and regulations, be supplied to all bicycle rental outlets for distribution to rental customers.

4 That the Vancouver Police department consider the use of trained police officers on bicycles to enforce traffic laws and regulations governing cyclists on the Stanley Park Seawall and the English Bay area.

4.24 Encouragement

The proper use of improved engineering facilities is dependent on cyclist education and education is dependent on enforcement, similarly the proposed facilities and programs are dependent on increased usage. The full benefits of a bicycle conscious city are attained through increased cycling. Cycling can be encouraged in three ways:

- ***by improved end-of-trip facilities;***
- ***by promotional/informational programs;***
- ***by intermodal transit links/facilities.***

As a result, two recommendations are proposed to improve parking, locker and shower facilities. These include:

1 That the City of Vancouver provide secure parking facilities at Vancouver schools, libraries, community centres, parks, museums and other public buildings.

2 That private developers be encouraged to provide shower and locker facilities in the development permit application stage.

These recommendations are based on recent study published in the *Bicycle Forum*, which found, in general, that an additional 1 - 2% of an employment centre's workforce can be

expected to commute by bicycle if secure parking facilities are installed, as well a further 1 - 2% can be expected to commute by bike if showers and lockers are also supplied.[1]

Cycling in Vancouver can be further encouraged through programs run by individual employment centres and by City-wide promotional campaigns. Employees are usually hesitant about cycling to work for several reasons. The most common reasons are: TIME; SAFETY; WEATHER; and, INCONVENIENCE. Therefore, in an attempt to promote increased numbers of cyclists, the plan recommends:

3 That the Park Board continue to hold Bicycle Sundays with the objective of encouraging safe cycling in Vancouver.

4 That fund raising cycling events be encouraged and supported by the City of Vancouver whenever possible.

Over one million people travel in and out of Vancouver each day from the surrounding municipalities. Only 16% of these trips are made using transit and over 84% are made by motor vehicle. The provision of intermodal transit links and facilities for cyclists, could result in a significant portion of these trips to be made by bicycle and/or a combination with one of the another modes. The dual mode transport has many benefits. Most importantly, dual mode transport with bicycles as one mode, would decrease the number of motor vehicles driven into the downtown core. The resulting benefits being decreased traffic congestion and a lower demand for motor vehicle parking in the city centre. To this end the plan recommends:

5 That BC Transit be requested to upgrade bicycle parking facilities at all Skytrain and Seabus stations.

6 That BC Transit consider providing bicycle parking facilities at all park and ride locations and off-street transit exchanges.

7 That individual municipalities be asked to consider providing bicycle parking facilities at transit exchanges where off-street space is not available.

8 That BC Transit consider:

- **i** allowing cyclists to use the Skytrain system during off-peak periods.
- **ii** permitting bicycles on the Seabus at all times to facilitate North Shore commuting.
- **iii** equipping express buses from Surrey and Delta with external bicycle racks to transport cyclists from major transit exchanges to designated unloading points in downtown Vancouver.

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[1] City of Vancouver Engineering Department, *Vancouver Comprehensive Bicycle Plan*, p.113.

4.3 EDMONTON, ALBERTA

The City of Edmonton has established four different forms of bikeway facilities throughout the city. The multi-use Trails are designed to accommodate all types of activities, including cyclists, skate boarders, roller skaters, joggers, etc. They are concentrated in the valley of the North Saskatchewan River and its many tributaries. The approximately 30 kilometres of trails are planned and maintained by the department of Parks and Recreation. Complementing this network are the 140 kilometres of bike paths, lanes and routes extending out from the valley. These facilities serve to transport cyclists from the downtown area to the suburbs. Where possible they connect with the extensive river valley, multi-use trails. As these are a part of the street network, the city department of Transportation is responsible for their planning and maintenance. Current city policy towards bike facilities is:

- To provide pleasant and functional cycling routes; and,
- To establish cycling routes which meet both the recreational and utilitarian interests of cyclists throughout the city.

The North Saskatchewan River has, over time, carved a striking 25 kilometre valley throughout the City. It enters the community from the southwest, bisects Edmonton, and exits to the northeast. In addition, it has five creeks and numerous ravines feeding into it. This has provided for expansive green spaces in the downtown which the city has safeguarded by creating over 20 parks in the river valley. Located immediately adjacent to these, are an additional half-dozen parks in the various creeks and ravines. In almost all of the parks there are hiking trails provided and in over half of the parks, bicycle paths can be found. A bicycle study conducted by the Edmonton Anti-Pollution Group in May 1973, provided the impetus for bikeway development in Edmonton. In response to this initiative, the *Bikeway Master Plan* and the *Bikeway Concept Plan* were developed by the Transportation Department, with the subsequent approval by City Council in early 1974. Both of these plans became incorporated into the city's overall Transportation Plan. The next major boost for cycling enthusiasts came with the City being awarded the 1978 British Commonwealth Games. To enable Edmonton to host the games, the bicycle network required enhancement to serve the cycling component of the Games. This was the opportunity for Edmontonians to receive a multi-use complex for cycling to meet the racing needs plus a recreational cycling path system. The velodrome was constructed near the downtown in the park network via the Mill Creek route.

Both the Parks and Recreation and the Transportation departments have recently examined their positions in regard to the provision of bicycle facilities. This has resulted in the formulation of a Parks and Recreation Position Paper, titled *Capital City Recreation Park Extension* and a Transportation department proposal for a *Five-Year Bikeway Program.* The position paper outlines Parks and Recreation's proposal to extend the river valley trail system to the southwesterly limits of Edmonton as part of the Capital City Recreation Park. The original park, initiated in 1974, stretches from the river bank adjacent to the Legislative Building (situated approximately in the centre of the length of the banks within the city boundaries), for sixteen kilometres, to Hermitage Park in the northwest. The park is used in all seasons. Trails follow the North Saskatchewan River winding through the rolling park terrain, offering opportunities for a leisurely walk, cycling tour, an intensive hike, or a relaxing atmosphere to enjoy nature. These same routes become trails for cross-country skiing, dog sledding, horseback riding and snowshoeing, during the winter months. Historic sites, athletic fields, informal play areas and golf courses, complete the park system.

The proposal within the position paper uses the philosophy that by limiting development to an integrated trail system it would make the river valley accessible to the public yet protect the natural landscape and wildlife habitat areas. The over-riding goal is to maximize access from the adjacent residential areas. To enable the development of the park proposals for the remaining river valley area, a number of principles were formulated to guide the project. These include:

- The continuation of a natural park environment;
- Limit trail development to only one side of the river valley interconnected by pedestrian bridges;
- Use easement agreements on private property for trail development; and,
- The reforestation of denuded areas.

A bicycle trail is proposed from the end of the existing trail at the Legislative grounds to the far southwest boundaries of the city. The trail system will be connected throughout the river valley by pedestrian bridges. When completed, it will allow a cyclist to travel on segregated paths for the entire length of Edmonton. To complement the bike facilities, a regional walking trail system is also proposed. Five parks within this portion of the valley will be developed and include the construction of amenity buildings that will be used as small interpretive centres, picnic shelters and piers and reforestation will be undertaken. As the major emphasis of this proposal is on trail development, a minimal land acquisition program has been formulated. As such, easement agreements with private

landowners will be the focus for land acquisition reducing overall costs. This idea is based on the approach taken in the Niagara Escarpment project which implemented a similar program and met with success. Table 33 outlines the financial estimates for the department of Parks and Recreation's proposals.

Table 33 Trail Development Cost Estimates

	Number or Length	Total Cost	Cost per km/item	Projected Major Maintenance Cost
Bicycle Paths	47 km	1 681 400	36 000	210 434 (5 year)
Walking Trails	43 km	885 600	18 000	41 000 (1 Year)
Pedestrian/Cycle Bridges	8	16 700 000	2 000 000	
Walking Bridges	18	180 000	10 000	

Source: Edmonton Department of Parks and Recreation, *Capital City Recreation Parks Extension*, 1986.

The Transportation Department has undertaken the establishment of a comprehensive approach to Bikeway Planning. Comprehensive planning involves the 4 E's of cycling, that is, Education, Enforcement, Engineering and Encouragement. This approach is similar to that taken by Vancouver, it acknowledges that it is of paramount importance to include all four components to achieve a successful bikeway plan. Edmonton's first step was the organization of the Cyclists Education Committee. This group is comprised of members from various levels of government departments and agencies, these include: Transportation, Parks and Recreation, Police, Provincial Transportation, Alberta Motor Association, Edmonton Safety Council, School Boards, University and Bicycle Clubs. This allows for the continual discourse among citizens who are closest to cycling in the city. The responsibilities of the committee include the following:

> **EDUCATION:** Public education and safety, driver training, Canadian Cycling Association Can-Bike I and II accreditation for cycling education and training of instructors, enforcement, registration of bicycles, and locating stolen bikes.
>
> **FACILITIES:** Parking, routes, educational facilities, showers, public transit access, bike repair, and detailed engineering.
>
> **ADVOCACY:** Promotion, coordinate input and output, bike month/week/day feedback, multi-use conflict, and re-evaluating legislation.
>
> **RESOURCE:** Distribute information to cyclists and other, internal communication, organize meetings between principal players, and promotion.

Other facets of the comprehensive approach that will be attempted, include; innovative engineering projects, increased enforcement and improved public relations. Additional cycling groups operating in Edmonton include: the Edmonton Bicycle Commuters - mandate is to improve conditions for the cycling commuter, encourages the use of the bicycle as a legitimate mode of transportation, offers a bike registration service and operates a bike repair facility; the Alberta Bicycle Association - affiliated with the C.C.A., represents bicycle racing interests in the Province and promotes bicycle safety; and, the Edmonton Bicycle and Touring Club - brings together individuals who share an interest in cycle touring. Projects that were accomplished in 1986 include:

- The creation of 3 Class I bike routes.
- Established pedestrian protection gates on the High Level Bridge.
- Upgraded the existing bikeway signage.
- The continuation of the Public Information Program, an important facet of the Bikeways program.
- Bikeway displays were set up at various events throughout the city.
- Two city-wide questionnaires were conducted. One solicited concerns and opinions about the city's bikeway program and the second collected information from the Edmonton Bicycle Commuters Club, to determine origin/destination data for the mapping of bicycle movements in the downtown.
- Bicycle counts were conducted at strategic sites throughout Edmonton.
- The city was involved in the Edmonton Bicycle Commuter's "Bike Ahead Week" that served as the impetus to study the feasibility of providing a bicycle lane to the downtown.
- A Cyclists Education Program was completed, which was designed to explore opportunities for increasing cyclists' knowledge and skill level to ride with traffic, and to create drivers' awareness fo cyclists.
- And lastly, the department updated the *Edmonton Bikeways* map. The revised map, *Cycle Edmonton*, reflects an emphasis in the need for both cyclists and drivers to understand and exercise their rights and responsibilities while using the roadway system. By providing information relating not only to the location of bikeways, but also potential cycling hazards, such as the location of arterial roadways, one-way streets, steep grades, traffic circles, bus lanes and caution areas. Thus cyclists are better equipped to choose the best route based on their cycling abilities.

In December 1986, the Transportation department completed its Five-Year Bikeway Program, (1988-92), that is designed to meet the bikeway objectives and policies as stated in the General Municipal Plan. Which are:

- To provide ancillary transportation facilities for functional and recreational use, such as, pedestrian facilities and bikeways.
- The City will develop and maintain a city-wide bikeway network for both utilitarian and recreational purposes.

To achieve these, four types of bikeway initiatives are employed. These include the three main classes of bikeways and fourthly, minor bikeway improvements such as signage, curb cuts and parking facilities, that will enhance cycling opportunities.

The Five-Year Bikeway Program is updated annually by the Transportation department. This process allows for the:

- Coordination with roadway construction programs and local improvements;
- Monitoring and identification of improvements to the existing bikeway network through public input and field surveys;
- Investigation of citizens' complaints;
- The coordination with Parks and Recreation, and any Planning and Building departments' construction programs and bikeway proposals; and,
- Assessment of technical and economic feasibility of the proposed projects.

Projects for 1987 included the continuation of a major bike path. Additional minor construction projects provided improved connections with the existing system and a facility is planned to improve pedestrian/bicycle circulation on the High Level Bridge. Construction proposals for 1988-92 include: the provision of additional bike paths, of which rumble strips would be used to delineate the roadway from the bike path and provisions included for the construction of 12 foot-wide paths; additional signage; a 2-way bike lane on a 1-way road by widening sidewalks to accommodate this two directional travel; and Class II and III bikeway facilities to improve the connections throughout the city while upgrading quality and maintaining a minimum safety standard. Construction cost projections, in 1987 dollars, and spread over the five years, is estimated in excess of $615 000.

There are additional projects that will operate concomitantly with the construction program. These include:

- The ongoing evaluation of the current bikeway facilities and the feasibility of implementing future ones;
- Increasing the publics awareness of the bikeways;
- Organizing interested agencies to improve the cyclist safety education programs; and,
- Address the availability of resources and locations concerning bicycle parking, showers and lockers for cycling commuters.

The City of Edmonton does not employ a Bicycle Coordinator, but rather a number of employees from different departments (Police, Transportation, Parks and Recreation), are active in the planning, construction, coordination and monitoring of bicycle facilities. As well, the City provides the bicycle Education Committee with information and assistance where necessary. The committee is currently in the process of forming on Advisory Board for Edmonton City Council. Although a commuter club exists in the city, there has been no studies done to determine whether the bicycle facilities provided have encouraged a move from the motor vehicle to bicycles. Bicycle counts have been conducted, but only at locations that have been deemed to be 'problem' areas or critical linkage sites. The first count was taken on the High Level Bridge in July 1987. The bridge allows for the continuation of a Class I bike path throughout its length. Between the hours of 6:00 AM and 9:00 PM, an average of 2 000 cyclists were recorded using the facility. The second count was during August 1986 and examined bicycle movement in and out of the downtown. During the peak period of 3:00 PM to 6:00 PM, 1 700 inbound and outbound cyclists were recorded. As the bikeway network has progressed, several significant problems have arisen. These include:

- The large number of cyclists in the downtown (particularly cycling couriers) has created numerous problems, which involve cyclists riding on the sidewalks, travelling in bus lanes and disobeying traffic laws.

- Problems are created when Class I bike paths meet local road intersections. Cyclists often assume that they have the right-of-way to cross the street. However, the facility itself, with the dropped curb cuts, may be inadvertently contributing to this behaviour. The law has been made clear on this issue, but operationally, the problem has been difficult to solve.

- There is some disagreement among City departments, agencies, cyclists and cycling advocates with regard to the bicycle facility requirements of the utilitarian (commuting) cyclist versus the recreational cyclist. The commuter desires quick, direct access routes, while recreationalists want safe, pleasurable routes. As such, Edmonton has made a conscious effort to develop a balanced combination of both direct access and recreation type routes.

- Conflict has occurred between pedestrians and cyclists using the shared, multi-use trails. Poor visibility and speeding cyclists are the most frequent causes for

complaints, and are cited as the major causes for cyclist/cyclist and cyclist/pedestrian accidents.

4.4 EUGENE, OREGON

The City of Eugene is Oregon's second largest community with a 1985 population of 193 000. The city bicycle program began in 1970 at the urging of a member of the city council and the mayor. This resulted in the creation of a staff-citizen bicycle committee whose mandate is to encourage bicycle use. The staff contingent is comprised of one member from each department: public works, traffic engineering, planning, parks and police. The committee was initially met with stiff resistance from the traffic engineer and other staff members who felt that a good bicycle program was not attainable.

By 1972 the members formulated a temporary bikeway plan by simply observing where bicyclists were riding or would likely be riding if they could, as well they undertook bicycle counts and identified barriers, (for example, paths that end at creeks because no bike bridges exist), in the community to bicycle travel. This prompted city staff to commit to a more comprehensive plan. The consulting firm of DeLeuw, Cather and Company of San Francisco was commissioned to do the study. The *Eugene Bikeways Master Plan* was formally adopted by city council in 1974. It is updated each year, and serves to guide the development of the City's cycling program. The council believed that nothing would be built unless a financial commitment was made to the program. To this end, council allocated a yearly allowance of $75 000 US in the capital budget for the construction of a bicycle facility.

4.41 Bicycle Committee

In 1975 the Committee created the position of the City Bicycle Coordinator. The Coordinator provides a reception point for all Eugene bicycle matters and is responsible for the day-to-day duties involving the construction and maintenance of the bikeway network. It is also charged with preparing the Bicycle Committee's agendas and oversees the distribution of minutes and materials for the monthly or semi-monthly meetings. However, the key element for the success of Eugene's popular system of bicycle lanes, paths and bridges is attributed to its citizen/staff committee. The composition of this dedicated group makes it possible for a continuing and innovative dialogue between staff professionals and lay people. The strengths of each group complement one another. The citizen members provide enthusiasm, a fresh perspective, innovative ideas and a voice for the bicycle

constituency. The staff provides the technical expertise, manpower for the more mundane tasks, and a tempering influence. In addition, the presence of a regular committee with a body of wisdom shared by the continuing members provides a buffer against the departure of any members.

The purpose of the committee is to advise the municipality of Eugene in regards to the encouragement and facilities necessary to elevate the bicycle as a regular means of transportation and recreation. The responsibilities of the committee include, but are not limited to, the following:

- **Bikeway Policy** - the committee reviews the Bikeways Master Plan at least annually and proposes plan amendments based on this review; establishes each year, a list of recommended bikeway priorities that are drawn up after the annual review and which serve as a proposed bikeway budget for the coming year; and maintains contact with metro and state bicycle programs and plans to ensure compatibility.

- **Bikeway Implementation** - review and approve preliminary any final plans for financing and creating specific bikeways, and attempt to resolve any conflict among staff, citizens, neighbourhood and other interested groups affected by any bikeway design and/or implementation.

- **Education and Enforcement** - promote and implement educational and law enforcement programs as outlined in the Master Plan.

- **Citizen Contact** - disseminate information to the public about existing and proposed bikeways and bicycle programs and encourage citizen participation in identifying problem areas, reviewing existing facilities, and planning and implementing new ones.

The *Eugene Bikeways Master Plan* required more than one year to complete and proposed 120 routes covering some 150 miles. In the seven years that has elapsed since the city government first included a provision of $75 000 in the capital budget for bicycle items, the city has constructed 21 miles of independent paths, 34 miles of on-street lanes and 15 miles of signed routes (the community has a population of less than 200 000). Sensing the immense popularity the Eugene bikeway initiatives were receiving and the potential a bike network can have, the Metropolitan Bicycle Committee was formed in 1975 to develop a regional bicycle plan. This plan ensures that bikeways, will transcend jurisdictional boundaries. In 1978 this plan was incorporated into the area's long-range transportation plan. This signalled the recognition that bicycles were an integral component of the transportation system. Bicycle policies and projects are helping the region achieve its goal of accommodating 15% of the total work trips in the year 2000 through walking, bicycling and car pooling.

The vehicle for modification and updating the plan, as recommended by the Master Plan itself, is the annual review. The Bicycle Coordinator solicits ideas from the city's eight neighbourhood groups, the Bicycle Committee and conducts public meetings. Most revisions have resulted in the addition of new routes to the original list of 120. Other amendments include route substitution, deletion or relocation - all of which depend on various factors, such as the direction of city growth. A new policy was added to the Plan in 1981, that reads "bicycle facilities shall be provided where applicable on all new or reconstructed arterials".[1] The inclusion of this statement acknowledges that route details must be altered in light of experience, that bikeway planning and design requires fine tuning and bicycles are to be regarded as legitimate road users.

In 1979, five years after the bicycle plan was initiated, a comprehensive evaluation was undertaken to study its effects. The evaluators concluded that the fifty miles of bikeways already built were serving the community well. Sixty percent of the city's bicycle commuters used the completed routes for over one-half of the length of their journey. Bicycle counts from 1978 indicated an average 76% increase over similar counts taken in 1971. Eugene's experience has shown that before bicycle use will flourish, especially among commuters, there first has to be some provision of bikeways. Accident data revealed that sidewalk bikeways had higher accident rates than other bikeway types, and that on-street lanes tended to reduce accidents. The data collected illustrated that by striping lanes, it lowered accident rates previously recorded. The lanes serve to remind motorists that cyclists might be present, thus making drivers more cautious when turning across the bike lanes. The lanes also provide for more predictable movements by both cyclists and motorists. There were five prominent factors which prompted Eugene to establish a trail system. First was the passage of state legislation in 1971 requiring that one percent of the state Highway Fund (ie. Gasoline Tax) be used for the construction of foot paths and bicycle trails. It soon received the nickname Oregon's 'Bicycle Bill' but it provided Eugene with an important source of funding. It was responsible for financing approximately one-third of the Riverbank Trails System. Today the one percent Bicycle Bill requirement remains intact, but projects like riverbank trails are no longer eligible. At the insistence of powerful lobbying by motorist organizations, the legislation was amended that now only allows state bicycle monies to improve highway shoulders, which benefit

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[1] Bikeways Oregon, Inc., "Eugene Bikeways Master Plan", *Bicycles in Cities the Eugene Experience*, Vol II, p.4.

both cyclists and motorists. Another factor was a strong local interest in parks. In the sixties and early seventies, public officials and private citizens won approval for park acquisition to form the large linear park on the north bank and smaller park additions on the south bank of the Willamette river.

A third factor was a state law encouraging a "Willamette River Greenway". In general, Oregonians had been neglecting their waterways, but this bill made it possible to develop green banks in the centre of Eugene. The state legislation assisted with land acquisition, easements and condemnation. The fourth factor was the city's bicycle program. The adopted bikeway plan recognized the river banks as the potential spine in the city's transportation system for cyclists. The Bicycle Committee, city staff and area residents became increasingly aware of river bank development. They began to carefully scrutinize each development to ensure that easements would be there to preserve lands for the future development of a river bank path. And lastly, there was the increasing number of path users. As each new section of the system was completed, it attracted new users who in turn, would then utilize the remainder of the trail network. The result is that three years after segments were constructed, areas along the trail had tripled in the level of use. Legislation has now been in place for seven years that; prohibits any future developments along the river from interfering with the access for the path network, grant river bank easements, and construct sections of the river bank trail system, where necessary, just as they are required to provide streets and other public amenities.

4.42 Bikeway Design

Eugene identified corridors where high bike/car conflict discouraged cycling. In other areas there were actually barriers, (for example, narrow bridges) to cycling that prevented commuting. In these cases, innovative engineering and well-designed bikeways reduced the conflict and enabled commuters to get to and from work.

The great majority of the city's bikeways are either separate paths or on-street striped lanes, there is however, some reluctance to put signed routes in place. Where signed routes are used, they have taken on characteristics similar to those of the separate bikeways, rather than typical street routes. This was achieved through the use of semi-diverters on narrow streets. The diverters channel car traffic to nearby and parallel arterial streets. Parking is only permitted on one side to serve the local residents. This neighbourhood street soon became known as a 'bicycle street', with more bicycle traffic

than the intersecting streets had car traffic. As such the engineering department relocated stop signs, and priority was given to the higher-volume bicycle street, over the car streets.

The Ferry Street bridge is Eugene's oldest and most heavily-used bridge, travelled by an average daily traffic of 50 000 vehicles. With its strategic location it also attracts high numbers of cyclists. Alterations, completed in 1976, have reduced the hazards to bicyclists and as such, increased the level of bike use. These changes included: widened sidewalks; concrete barriers and railings, protecting sidewalk users from cars; and a ramp linking the bridge sidewalk directly to the river bank trail. The bicycle network was enhanced through innovative planning which allowed for the addition of four bicycle/pedestrian bridges spanning the Willamette river. As the community on both sides of the river grew, it soon became necessary for the utility companies to expand their services. Over a period of twelve years, three bridges were constructed to carry a new water main, new sewer line and a conduit for steam across the river. The bicycle committee sensed a unique opportunity and was able to convince the utility companies to alter their designs to accommodate the path users. The committee was made aware of the utilities plans for the bridges through the knowledge that each committee member brings to the meetings. These bridges now connect over ten miles of asphalt trails along both banks of the river.

To provide space for bike lanes on some busy arterials, Eugene narrowed car travel lanes to 11 feet and turning lanes to 12 feet. On some collector streets car travel lanes have been narrowed to 10 feet. An unanticipated result of the modification to narrower travel lanes has been the lowering of car speeds along the route, benefitting residents along the street and cyclists using the route. It is not recommended for all situations, but in an effort to gain extra roadway room, Eugene narrowed parking lanes and bike lanes. This was successfully because the parking turnover was low and traffic volumes were under 7 000 per day. The bikeways, depending on a variety of conditions related to the street, may vary in width from 4 feet to 6 feet. On-street drainage grates are being replaced by curb inlets that gather water under the curb, rather than collecting it on the street, directly in the cyclists path. These are used for streets with curb-side bike lanes, streets with high bicycle use, and in all new or reconstructed streets. As well the city has begun using 4 1/2 foot-wide gutters instead of the usual 1 foot wide concrete gutter. This has resulted in two distinct advantages, first, the contrast in colour between the asphalt road and concrete gutter helps alert motorists to the bike lane and to be aware of the possibility that cyclists may be using the lane, and secondly, the longitudinal joint between the roadway and gutter is moved from the cyclist's normal area of use thus possibly preventing an accident. Since 1976,

Eugene requires that driveway lips or joints between road and path be less than 1/2 inch. Previously these joints may have been as high as one or two inches, this resulted in damage to the bicycle wheel or caused numerous a spills. As part of routine street cleaning maintenance schedule, on-street bike lanes are swept regularly. Also, by extending asphalt paving into driveways and parking lots that both have gravel surfaces, the amount of gravel that is tracked-out onto the path, is greatly reduced. This helps reduce the maintenance budget for bikeways by minimizes the frequency of sweepings.

4.43 On-Street Bicycle Lanes

By 1982, Eugene had obtained space for striped bike lanes in the following ways: removing car parking (7.5 miles created); providing sufficient width for bike lanes when building new streets or reconstructing streets and intersections (20 miles); narrowing car lanes (9 miles); and eliminating a car lane (0.5 miles). Bike lane widths usually are 5 feet but it may be as wide as 6 feet or as narrow as 4 1/2 feet.

Striping

The decision to place a stripe on a given street is based on evidence of existing high bike/car conflict and on the lack of an acceptable, alternate bike route. Eugene has no law requiring cyclists to use the lanes when provided; however, most cyclists do so because the lanes are well-placed. The bike lanes are striped with a solid, white 8-inch wide stripe between the bike and car lanes. Approaching an intersection, the stripe is dashed to caution the cyclist and the motorist of the increasing risk of turning movements. When the bike lane is moved out from the curb to allow space for parking, an additional stripe is needed. This narrower 4-inch stripe is added when parking is so light that drivers mistake this space for another car lane.

Turn Lanes

Turn lanes make for difficult design problems for bikeway engineers. Frequently the space required for a turn lane or turn pocket may occupy the bike lane space. If this occurs, the bike lane is usually discontinued in advance of the turn lane and a sign erected stating, *Bikes Merge*. The space for both a right-turn-only lane and a bike lane comes from dropping the parking lane. Or the intersection may be widened to provide the needed room. In this instance the right-turn-only lane is placed to the right of the bike lane. (See Figure 19). This striping configuration encourages the turning motorist and the bicyclist travelling through, to cross paths in advance of the intersection, rather than in the immediate vicinity of, it. The 8-inch wide line is dashed through intersections. The line is

also dashed rather than dropped, when bike lanes approach right-turn-only lanes. This encourages motorists to use caution when making their lane change across the bike lane.

One-Way Streets

Two one-way streets striped for bike lanes in downtown Eugene serve as the principal north-south commuter routes for both bicycles and automobiles. Heavy right-turn movements on the streets threatened the usefulness of the highly desired bike lanes. Placing the bike lanes on the left side of the street instead of the more accustomed right side, solved the problem; bicyclists avoid conflicts with double right-turn lanes, bus stops, and also frequent right-turn movements into mid-block parking lots. Directional arrows in the lanes, police warnings and citations, and peer pressure all emphasize the proper riding direction.

Eugene has many one-way streets. Two particularly narrow ones, located near the University of Oregon, have a high demand for two way bike travel. In the early seventies, when the streets carried two-way automobile traffic as well as bicycles, the bike-car conflict was very high. Widening the 24-foot wide street would have meant losing the trees that border the street. The innovative solution placed a one-way, 12-foot wide car lane down the middle of the street, thus allowing a 6-foot bike lane on each side. The bike lane in the direction of traffic is striped with the common 8-inch wide white stripe. The contra-flow bike lane on the opposite side of the street has a 8-inch stripe plus a double yellow stripe. Each intersection and major driveway has a sign cautioning motorists that the street has two-way bike traffic, in addition to one way automobile traffic. This unique approach is not applicable to all situations but it did alleviate the problems associated with narrow streets and high bicycle volumes, and serves to illustrate how barriers to bike travel can be overcome with innovative design.

Six of Eugene's most used on-street bike lanes occupy former car parking space. Parking on arterial and collector streets, in most cases, is prohibited by city policy. This project has proved successful, results one year after completion show less car congestion, a lower bicycle accident rate, and more bicycle use.

Intersection Design

Eugene employs two basic designs for bike lanes at intersections. One locates the bike lane at the curb. The other moves the bike lane inward to allow for a vehicle turn-only

lane at the curb. Traffic volumes, turning movements, street widths and right-of-way availability all influence design. (See Figure 19).

On some bike lane streets, high traffic volumes warrant separate vehicle turn-only lanes. At these intersections, the turn lane, not the bike lane, is placed adjacent to the curb. A parking lane becomes a right turn-only lane at busy intersections and the bike lane moves inward. With this design, the through-riding bicyclist and the turning vehicle cross paths in advance of the intersection. On streets where there is no parking lane, the intersection is enlarged to allow for a right-turn bay to accommodate heavy turn volumes.

Most bike lanes in Eugene are curb-side lanes. On these streets there is typically more through traffic than turning traffic. The bike lane stripe continues as a dashed line through the intersection. The dashing begins long before the intersection and continues for 50 feet beyond. While both motorists and cyclists must learn to be wary of each other on these bike lane streets, the predictable location of each seems to help. The presence of large numbers of cyclists increases motorists' awareness and caution at intersections. Cyclists needing to merge across traffic to the opposite side for a turn, begin their move a block before the intersection. Although many less confident cyclists may choose to dismount and cross the intersection as a pedestrian. When streets with bike lanes have sharp turns, motorists tend to infringe on the bike lane. Ramps at the street corners give cyclists the option of cutting along the sidewalk if the traffic infringes or is too heavy.

Parking

Streets are only half the urban automobile equation; parking is the other half. This also holds true for a bicycle network. Bicycles have characteristics that require well thought out bicycle parking facilities. Bicycles are easy to steal, are a nuisance for pedestrians when parked around building entrances, and are uncomfortable to ride after they've sat in the rain or snow. One attribute of bicycling most valued by cyclists is the ability to place the rider very close to their destination. The first step in providing parking facilities is to first, identify the cyclists' destinations. Simple observation illustrates where bicycles cluster - hospital, library, university, shopping malls, municipal offices, etc. are common locations. The next step is to provide parking in these places.

Bicycle parking facilities should be inexpensive, easy to use, esthetically pleasing, be easily maintained and resistant to vandalism, provide protection from the weather and a means of locking the bicycle securely. Each rack design is strong in some of these areas

and weak in others; each city district determines their own choice depending on the area's needs.

The role of the bicycle in easing downtown automobile parking problems has not been lost in Eugene. As many as 15 bicycles can be parked in the space needed to park one car. Consequently, several public buildings in the city have been designed with bicycle parking included and city planners point out the bike facility requirements to developers. The Eugene zoning ordinance requires that bicycle parking be provided with new apartment construction. Though not required to do so, many businessmen have seen the advantage of providing bicycle parking, both for aesthetic and economic reasons. Eugene's large cycling population tends to patronize businesses that provide convenient and secure bicycle parking.

4.44 Off-Street Bicycle Paths

Paths adjacent to the Amazon drainage canal and to the Willamette river account for most of Eugene's 21 miles of off-street bike paths. Because of their strategic location close to the city centre, these long paths serve commuter cyclists as well as recreational riders. Commuter cyclists are reluctant to go far out-of-direction to use off-streets path. But fortuitously, some of Eugene's off-street paths provide more direct routes for commuter cyclists than do the city streets.

Built in 1971, Eugene's first and only 8-foot wide path proved dangerously narrow due to its shared use by pedestrians, joggers and bicyclists. This minimum standard was quickly enlarged to 10 feet, and then again to 12 feet. This second increase was made necessary to accommodate the traffic that was generated by the immensely popular paths. Where access from paths to adjoining property must be prevented, chain link fencing is used. A wooden fence or a chain link fence with wood inserts provides visual screening where paths border private residences.

A 4-inch wide white edge stripe is used to help guide cyclists at night, whether or not path lighting is provided. Yellow centre lines are used at sharp curves, narrow undercrossings or locations where sight distance is restricted. Eugene employs workers on bicycles with an attached cart of tools, this allows the workers to travel along the path and carry out the maintenance needed.

4.45 Signing and Lighting

The 70-mile bikeways network is comprised of 21 miles of independent paths, 34 miles of on-street lanes and 15 miles of signed routes. Since 1971 more than a thousand bicycle signs have been installed to mark the network. Bicycle oriented signs aid cyclists in much the same manner as traffic signs assist motorists. The signing program helps cyclists find their way around town, helps them through difficult bike/car conflict areas, and warns motorists of their presence.

Warning signs, similar to those used for motorists, are used on the bikeway system when caution is advised. Regulatory signs inform motorists and cyclists what they are and aren't permitted to do. Traffic engineers in Eugene are careful to install stop signs only when warranted, knowing that bicyclists respect the signs only if the need is apparent. Occasionally, if bicycle traffic grows to exceed the automobile traffic on the cross-streets, the city will switch the stop signs to favour the bicycle flow. At some busy intersections the city has installed large push buttons at curb side and elbow height to enable cyclists to actuate traffic lights. New bicycle-actuated detector loops are being installed in the street. They are carefully positioned to ensure that they are in the cyclists path of travel, however these are currently only in the experimental stage. Existing automobile detection loops are relatively insensitive to bikes, but new stencils are being designed to guide bicycles to where the loop will best detect them.

Eugene's climate is mild enough for year-round riding but a recent survey revealed that the early darkness in the winter discouraged half the city's regular commuters. New lighting on some paths and bridges adds to the safety of winter commuters and encourages riding during the summer evenings. The style of street lighting chosen are vandalism resistant. Two types of lamp bulbs were considered, mercury vapour and sodium. The sodium lights emit a yellow light but were chosen because its power consumption is less than the mercury vapour, a significant factor when financial resources are limited.

4.46 Promotion

Promoting bicycling in Eugene is an easy task among the already-enthusiastic cycling population. But educating cyclists to ride effectively and safely is a more arduous task. The Eugene bicycle map is printed on waterproof paper to allow for its use in all types of weather, but it also includes additional information useful to the occasion cyclist. Included with route designations, the map also marks schools and other major destination points, indicates the locations of major hills and danger sites, and indicates bicycle rental

locations and repair shops. The police department has produced a brochure to assist bicycle owners to protect their investment. Another pamphlet makes a direct effort to lure new commuter cyclists. This pamphlet is frequently distributed to motorists as they wait in traffic jams. Also important to the city's promotional program is the rides and tours conducted by the Parks and Recreation department. The city's two part-time bicycle coordinators play a big part in the education and promotional efforts. They serve to disseminate information about the city's cycling program to the public, speak to schools and civic groups and are a contact for the news media. Police encourage proper cycling behaviour through the enforcement of bicycle by-laws. Off-street paths are patrolled by police on bicycles and mopeds.

Mandatory bicycle licencing first began in 1972, but was repealed by city council five years later. It did not discourage bicycle thefts nor generate extra revenue. Licencing problems centered on; the use of existing bicycle frame serial numbers, frequent changes in ownership and address, a sample effort to renew by mail yielded only a 17% response rate, enforcement was not practical, and costs exceeded revenues. When purported benefits, such as enhanced recovery of stolen bikes failed to materialize, voluntary compliance declined and bike shops stopped cooperating. The current licencing program is not mandatory. The bike is stamped with the owners/parents drivers licence number. Since driver licence numbers are already part of the State computer system, information retrieval for stolen bikes is simplified.

4.47 Funding

Eugene began its bike program in 1971 with no money. At the time, bikeways were considered frills, non-essentials, unlike streets and traffic signals. To finance the bicycle network the bicycle committee had to lever funds from all three levels of government and private sources where possible. Since 1974 the city has budgeted an average of $75 000 each year for bicycle facilities. This money has been used to match available Federal and State grants and for individual city projects. When bike lanes are added during the reconstruction of collector or arterial streets, the cost is not usually charged to the bicycle budget. State funds have come from the 1971 Oregon Bicycle Bill, which mandated governments to direct 1% of the gasoline tax to construct pedestrian/bicycle paths. National funds came from the: Federal Aid Urban Funds; Bureau of Outdoor Recreation; CETA; and Community Development fund. Financing for some projects were jointly shared by public and private agencies. Examples of this include the four bicycle bridges which were cost shared by the city and utility companies. And lastly,

money was procured through private donations. Neighbourhood groups generated revenue for the construction of bikeways and improvements to facilities in their area. The local media also provided spot announcements for publicity and safety programs.

4.48 TransPlan

The *Eugene-Springfield Metropolitan Area Transportation Plan* (TransPlan) was produced in 1986 and is designed to serve as the region's long-range transportation plan. TransPlan is a functional plan which supports the *Metropolitan Area General Plan* and replaces the *Eugene-Springfield Metropolitan Bikeways Master Plan.* It is not tied to any specific date, but contains policies that are designed to guide the growth, employment and land uses in the area. The goal of TransPlan is to provide for a more balanced transportation system to give mobility to all segments of the community. To this end the plan proposes shifting 15% of all anticipated work trips in the future, from the automobile to walking, carpooling and bicycling, and an additional 8% is planned for transit.

Eugene's approach to bikeway planning has proven successful. The 1980 U.S. census revealed that bicycle use for commuting to work was higher in Eugene-Springfield than in all but a few other communities in the United States. Reasons for this high level of use include; the area's many bicycle facilities, especially on-street bicycle lanes, independent paths and bicycle/pedestrian bridges. The bicycle component of TransPlan assumes a continuation of this trend towards greater use of the bicycle by enhancing the present level of facilities. The plan recommends 176 bicycle projects over the next 12 years. This would create over 80 miles of bikeways and countless improvements. The 176 have been chosen because they are considered essential to maintain a certain level of bicycling safety, to expand access and upgrade the level of service in the Eugene-Springfield area.

For many urban trips, the bicycle has proven to be a practical mode of transportation and is considered a viable substitute for the car or bus in many circumstances. In order to encourage its use for utilitarian purposes, routes have to be selected which emphasize directness and minimizes travel times, identical factors that motorists consider in their choice of routes. Because of these similar demands on the street network, a conscious effort has been made to provide bicycle facilities which serve corridors used by motorists. This has resulted in a predominance of on-street bicycle lanes situated on collector and arterial streets. It is hoped that this approach will enable Eugene-

Springfield to achieve its goal of shifting a minimum of 5% of all future automobile trips to the bicycle.

The city of Eugene is perhaps one of the most often cited examples of an all-round bicycle city. Its examination is in itself worthwhile in helping to understand the role of the bicycle within the city's transportation policies. It details the challenges which advocates of the bicycle must address if it is to be funded by government and its use expanded. In addition to the specific recommendations gleaned from the Canadian examples, they also serve to detail the bicycle developments in each of their cities. Chapter four has provided a thorough understanding of the process of bike planning and the role the bicycle has in some communities. This is of paramount importance, as it will allow the transportation planners in Winnipeg to follow the lessons learned these four communities, thereby helping to minimize costs. As well this comparison illustrates how the bicycle is currently interpreted and planned for, by the city government, and how the level of facility development in Winnipeg has fallen far behind other Canadian cities. Chapter five summarizes the practicum by initiating the formulation of a bicycle master plan for the City of Winnipeg and listing the process this would follow. Incorporated throughout this master plan would be the adoption of recommendations and procedures outlined throughout the chapters.

CHAPTER FIVE
RECOMMENDATIONS for WINNIPEG

Experience in communities like Eugene, Oregon and Davis, California have shown that when bikeway facilities are constructed the city residents will respond with immense support and use of them. A lack of government commitment to providing facilities will result in no appreciable increase in the level of bicycle use. A study in Davis concluded that "no bikeway facilities - no bicycle use".[1] This is crucial because the bicycle projects undertaken in Winnipeg have met with success. This includes the *test* cycling path through Assiniboine Park; the cycling lane on Henderson Highway; and the Sunday closure of selected city streets. The projects were developed to determine the level of demand for cycling facilities, if they met with success additional projects were to be undertaken. Each project proved overwhelmingly successful in terms of the number of users. Thousands of users travelled the routes but over time the demand waned. This is in part due to the lack of continuity with project development and limited facilities. It is necessary that the path network be expanded in subsequent years to increase the level of challenge to the user and permit greater bike access throughout the city. A government that is willing to commit itself to the financing and promotion of bikeways will see the residents respond with greater use of the bike. This leads to the challenge of convincing decision-makers to finance unproven bicycle projects during times of budget constraint and when demand cannot be readily identified. Success will depend upon illustrating how the provision of bikeways can actually save all levels of government money over time.

It is estimated that an asphalt bicycle path built with the accompanying lighting, signage and benches will cost approximately $50 000 dollars per mile. Costs of a bike lane are significantly lower as they are typically incurred during the costs of rebuilding or constructing new roadways. In 1987 Canada Fitness stated that if an increase in physical exercise prevented even one heart attack it would more than pay for the costs of providing the program (Sharratt and Cox 1985:41). Thus one area that cycling can have a significant impact on cost savings is in the field of health-care. Encouraging the use of bicycling through the provision of bikeways the "public" health can be improved. Health-care administrators recognize this fact and look to raising the level of health among residents as a means of reducing future expenditures on health-care related needs. In Canada during

[1] Robert Sommer and Dale F. Lott. *The Davis Experience.* Psychology Department. University of California. Davis, California. 1971.

1982, over $30.1 billion dollars was spent on health-care an increase of 16.8% over 1981. This trend shows no sign of slowing as health-care has consumed an increasing portion of all government expenditures. Improved health through cycling will not only lower government costs, but also costs to business. When an employee is injured or dies prematurely, the employer incurs the costs of lost working hours, retraining, sickness and bereavement. If in Manitoba bicycle facilities had been in place during 1987 and thus encouraged safer cycling, it is possible some of the 402 bicycling accidents and 7 bicycling fatalities may have been prevented. Hudson estimates that 409 accidents cost Manitoba in excess of $3 million dollars for the one year.[1]

Therefore a second area where cycling may save government money is in the provision of services. The switch to bicycles from automobiles for commutes to work may result in numerous cost saving measures to the city. First, a reduction in the absolute number of automobiles may postpone the need for the continual expansion and widening of city roadways to meet the travelling needs in the suburban areas and lower the amount of major road repairs. Subsequently, the reduction in traffic congestion on the streets will enable the automobiles remaining to work harder and more efficiently. Second, the use of public transit may rise through the potential of dual-mode commuting linkages. If secure bicycle parking facilities are provided at strategic bus stop locations, the effective range of households now covered by transit would be enlarged thus allowing them to penetrate deeper into communities from the regional street system. An increase in users would help offset the yearly deficit that transit operates. Third, a switch from automobiles will lower the level of contaminants added to the environment yearly. This decrease may result in a decrease in the degree of environmental degradation and improve the city's air quality resulting in less demand placed on health facilities by those afflicted with respiratory ailments. Lastly, if bikeways are planned with schools as an significant generator of cycling trips, then students may be enticed to use their bicycles for travel to and from school during the non-winter months. This will assist in alleviating the cost of busing students. Winnipeg currently has one of the highest levels of busing among its students. In 1987 the city school divisions bused approximately 21 660 children over the 193 school days for a total of 5.2 million kilometres driven. The average cost on a per student basis was $392 dollars or $1.63 per kilometre driven.[2] With extensive bicycle facilities Davis,

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[1] The cost breakdown, on average, is $4 320 dollars for an accident, and $183 600 for a fatality. Costs considered arise from: police and administration; medical and ambulance services; damage to property; lost output/productivity and pain, grief and suffering.

[2] Manitoba Department of Education.

California recorded exceptionally high levels of bicycle use by students when compared to nearby communities with little or no bikeways.[1]

Bicycle Funding

Funding for bicycle facilities may come from a variety of sources at the local level. There are typically seven potential sources.

1 *GENERAL REVENUE* - probably the most common source of funding for bicycle facilities and programs, despite the competition for these funds for alternative uses.

2 *DEBENTURES* - these bonds are more typically suited to financing large capital investments than for maintenance costs or small investments of an on-going nature.

3 *SPECIAL ASSESSMENTS* or *IMPROVEMENT TAX* - these are levied against a particular geographic area to finance a bikeway which will benefit primarily that same geographic area.

4 *BICYCLE REGISTRATION FEE* - the main purpose of this program is for increased bicycle security; however, registration fees can be sufficiently high as to cover administrative costs of the program and also provide a surplus for capital facilities.

5 *BICYCLE TAX* - this tax can be assessed at the time of bicycle registration but may be better suited to take the form of an increased sales tax on the purpose of a new bike.

6 *BICYCLE LICENCE FEE* - many communities require a bicycle operator to possess a licence before he/she may ride on thoroughfares. The licencing fee produce a surplus beyond administrative costs of the program which might go for capital bicycle facilities investment.

7 *PARKING RECEIPTS* - in many urban areas bicyclists may be willing to pay even a relatively high parking fee for a parking facility that offers good security and surveillance.

Various departments at the Federal and Provincial levels of government, like Amateur Sports and Fitness, Health and Welfare and Transportation, may provide public funds to help finance bicycle facilities. In addition, there may be many miscellaneous sources of funds at the private level. Some organizations have a special interest in recreational facilities and the preservation of natural areas, and can therefore assist in granting available lands or monetary contributions.

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[1] Among junior high students Davis experienced 80% of students travelled to school by bike while nearby municipalities averaged 38%. Among high school students these figures drop to 60% and 7%, respectively.

Bicycle Planning

The process of bikeway implementation and master planning requires a systematic approach. The implementation process is broader in scope than the actual bikeway plan and gives the planner a broad framework for bikeway development. The crucial step in the process is to secure the support of the government as they decide the direction of city policy and priorities and subsequently the funding for such bikeway projects. Once they have committed to a bike plan the implementation process should then include:

1 *OBJECTIVES* - the set of objectives should be comprehensive and clearly defined.

2 *INFORMAL STUDY* - the study should analyze cycling goals, needs and problems. During this process groups and agencies should be contacted for their knowledge, expertise and experience. Organizations consulted include city police, school boards and principals, community and service clubs, bicycle interest groups. and the planning agencies involved at the local level.

3 *ANALYSIS of DEMAND* - can be best accomplished through the use of surveys, interviews, and observations. The analysis should include number and age of cyclists, cycling patterns, classification of bicyclists into user groups based on their purpose of trip (commuter trip, utility trip, recreational trip and sporting/racing trip), existing conflicts between cyclists and other modes of transportation, existing plans for cycling support programs, and an inventory of existing and potential facilities including unique physical/environmental factors.

4 *COMMUNITY PARTICIPATION* - an integral part of the planning process to support and review functions.

5 *DEVELOPMENT of a BIKEWAY MASTER PLAN* - with review mechanisms and an emphasis towards funding sources. The master plan should include well defined goals, a statement of the dimensions of the current and projected demand, a community awareness and promotion campaign and the availability of alternative bikeway routes. These secondary bikeway routes will become very important with respect to available funding. The plan should also include the proposed layout of routes, construction, specifications, cost projections, and the scheduling of implementation. The public should have ample time to review and understand the plan, and their reactions should be actively solicited.

6 *IMPLEMENTATION* - of the plan and further investigation of alternative means of financing development through Federal, Provincial and local sources.

7 *SAFETY CYCLING EDUCATION PROGRAM* - for the public should be developed with the participation of local groups such as the police, school officials, community groups, along with the general public awareness of laws and outline the advantages of bicycling. This effort would supplement those of the Manitoba Public Insurance Corporation but would emphasize greater involvement of parents in the deliver of the education component and focus on cycling manoeuvres/behaviour which is the most frequent contributor to cycling accidents.

8 *REVIEW PROCESS* - should be developed on a continual basis to monitor and re-assess local demand as the framework for future planning. This process is undertaken because of the long-term nature of implementing a bikeway system. With experience of the initial system and newly developed data, changes to the future portions of the system become feasible.

Planning Goals

Goals are broad general statements of a desired future state of affairs. Objectives are more specific statements of changes or conditions that must be achieved in order to reach a stated goal. In developing a bicycle master plan for Winnipeg, four goals should serve as the guiding force. The goals and objectives can be summarized as developing a comprehensive, balanced and integrated bicycle facilities system that encourages and expands bicycle usage made safe and accessible by a coordinated program of physical improvements, safety education and enforcement. The goals and objectives identified are as follows:

GOAL 1: DEVELOP A NETWORK OF COMPREHENSIVE, ADEQUATE AND INTEGRATED BICYCLE FACILITIES THAT ENCOURAGES AND EXPANDS USAGE, AND SERVES THE BICYCLING NEEDS OF WINNIPEGGERS IN AN EFFICIENT AND AESTHETIC MANNER.

Objective A: *Improve the bicyclist's accessibility to residential, employment, shopping, educational, recreational, historical, institutional, and other public areas.*
Objective B: *Adequately serve all types of bicycle movements (inter-community, inter-neighbourhood, intra-neighbourhood, etc.).*
Objective C: *Create and integrate planned and existing bicycle facilities into an inter-connected and continuous system.*
Objective D: *Make bicycle facilities planning an integral part of the comprehensive, multi-modal, coordinated and continuing transportation planning process in Winnipeg.*
Objective E: *Remove physical barriers to bicycle travel.*
Objective F: *Encourage the multiple use of public right-of-ways for bicycle facilities.*
Objective G: *Improve bicycle security by providing and encouraging adequate bicycle parking and storage facilities.*

GOAL 2: PROMOTE BICYCLING SECURITY BY PROVIDING AND ENCOURAGING ADEQUATE BICYCLE PARKING AND STORAGE FACILITIES IN ORDER TO REDUCE THE DEPENDENCE ON THE AUTOMOBILE AS THE DOMINANT TRANSPORTATION MODE.

Objective A: *Encourage all types of bicycle use (commuter, tourist, racing, recreational, etc.).*
Objective B: *Through the media, promote public awareness of bicycle facilities and encourage bicycle use.*

Objective C: *Develop a variety of pamphlets and maps which provide bikeway locations, parking stalls, street conditions, "bicycle-safe" streets, scenic and historic routes, road safety tips, and general bicycling information.*

Objective D: *Integrate bicycle facilities with public transportation.*

Objective E: *Ensure that bicycle facilities requirements are adequately addressed in consideration of all road and bridge construction and reconstruction.*

Objective F: *Provide positive incentives and bonuses to developers (both public and private) which encourages the development and continuation of bikeways, and restrict any construction that will inhibit current and future bicycle use.*

Objective G: *Improve the bicycling environment to encourage the use of the bicycle (by providing adequate lighting, and enforcing laws, etc.).*

GOAL 3: PROVIDE FOR SAFER BICYCLING IN WINNIPEG.

Objective A: *Design and coordinate a bicycle facilities system that minimizes traffic conflicts among bicyclists, pedestrians and motorists.*

Objective B: *Increase general public awareness of the bicycle, its operating characteristics, and the bicyclist's rights.*

Objective C: *Increase the knowledge of bicyclists of all ages to their responsibilities, and safe bicycle operation to ensure cyclists behave and adhere to car driver rules.*

Objective D: *Increase the motorist's knowledge of the bicyclist's rights and bicycle operation.*

Objective E: *Give adequate consideration to the safety of the bicyclist in the planning, design, and construction of public works improvements.*

Objective F: *Increase the enforcement of traffic laws concerning the movement of bicyclists, motorists and pedestrians.*

Objective G: *Ensure and improve the maintenance (including surface, signing, debris removal, street sweeping, and eliminating any physical impediments) of bicycle facilities.*

Objective H: *Enforce the laws requiring the use of adequate safety equipment by the bicyclist, and the maintenance of the bicycle in safe working order.*

Objective I: *Require bicycle registration.*

GOAL 4: ENSURE THE EFFECTIVE UTILIZATION OF RESOURCES AND THE PROVISION OF ANCILLARY SERVICES TO SERVE THE BICYCLING NEEDS OF WINNIPEGGERS.

Objective A: *Provide an adequate level of funding for bicycle facility construction, operation, and maintenance.*

Objective B: *Ensure the involvement of citizens, interest groups, transportation specialists, recreational specialists, and bicycle users in the planning, programming, and implementation process.*

Objective C: *Develop guidelines for the effective expenditure of capital improvement funds for bicycle facilities.*

Objective D: *Ensure the integrated development of bicycle facilities in conjunction with all area development plans.*

Bicycle Coordinator

The implementation process provides the department of Parks and Recreation a broad framework for bikeway development. As there are two main types of bikeways; the

separated bike path and the on-street bike lane, the responsibility for each should devolve to city departments with the appropriate expertise. Most cities have experienced best results when bike paths are planned by the department of Parks and Recreation and bike lanes/routes are run under the auspices of the department of Streets and Transportation. The resources of each department lends itself best to this form of division. Each department can then be responsible for committing a portion of their yearly budget to fund the on-going development of a bikeways plan. To link and coordinate all bikeway developments, the position of **Bicycle Coordinator** should be created. This position may be located in either department, but the primary responsibility would be to oversee the implementation of the bikeways master plan. As two city departments will be responsible for the bicycle facility development, it is important that the bicycle coordinator maintain strong communication links between these departments to ensure that the plan is effectively and efficiently implemented. Additional duties for the Coordinator should include the following:

- A contact source for the media, public, and all government departments for information or complaints on all cycling related matters;
- Plan all bicycle committee meetings, and is ideally suited to set the agenda for the meetings;
- Promote the encouragement of bicycling through various mediums, including:
  - operating a "bike phone line" where residents would be able to call if certain bike paths/lanes required immediate repair or needed information on upcoming events,
  - write a cycling newspaper column and produce a monthly cycling newsletter, these would provide information and allow a forum for the discussion of cycling issues, as well as heighten the awareness of cycling developments to the non-cycling public.
- Develop a new informative cycling map that would provide the user with better details regarding route condition. This would include site locations of stop lights/signs, street gradients, conflict points, traffic volumes, in addition to safe cycling tips.
- Formulate an improved educational program to supplement present efforts but with a special focus on high risk groups and conditions. This includes locations of frequent accident sites, emphasize on groups that are over-represented in accident statistics, and ensure educational information is more available to parents of children. Greater numbers of children can be reached and be taught more thoroughly and frequent if parents are used as the primary source of safe cycling techniques. It is of paramount importance to strengthen and coordinate programs currently offered in schools to reach all students.
- An on-going responsibility would be the updating and adapting of educational material as laws and conditions continually change. This would include campaigning for the revisions of the *Driver's Handbook* and drivers tests that

would include information and questions especially pertaining to automobiles and bicycles sharing the roadway. It is necessary to also expand the level of information contained in the *Bicyclist's Handbook*. This would result in sections of the book being oriented to varying age cohorts, ie. children, teens and adults. The information becomes more technical and comprehensive as the level of skill increases.

- Actively solicit funds from public and private sources and to ensure the efficient use of monies by developing a priority system for project funding.

- Finally, the coordinator would ensure that all bicycle projects adhere to the standards contained throughout the report. The coordinator would oversee all bicycle developments to maximize linkages and review all development plans to safeguard against the erection of barriers which may prevent future bikeway connections and continuity.

Bicycle Advisory Committee

To assist the Bicycle Coordinator with the duties outlined and to provide direction to the future of bicycle developments within the city, it is recommended that a **Bicycle Advisory Committee** be established. The committee members would include people from various government departments who are most familiar with the issues related to bicycling, ie. police, Parks and Recreation, Streets and Transportation, school boards, Community Committees, cycling groups, bicycle retailers, Manitoba Public Insurance Corporation, etc. This format helps facilitate input from organizations concerned with cycling and allow for effective discourse among members. It provides for a range of citizen points of view on all bicycle-related matters and helps ensure that the two city departments responsible for financing bikeways understand the direction of policy and any new developments, within each organization.

A system of properly functioning, efficient and destination oriented bikeways will encourage the public to cycle more frequently and entice many first time users. But the reticent attitude of government departments to finance cycling paths comes from the belief that their use is greatly inhibited because of their high cost and restricted by seasonality. However, the argument has been established throughout the report that a network of bikeways may actually *save* governments and business money over the long term. This would be through reductions in the cost of maintaining and developing the urban infrastructure and lowering medical costs by improving the level of health among the public. In addition the facilities may be used year-round if they are properly cleaned and maintained. Widespread use of the bicycle on city streets during the winter will attest to this. Although a second option may be to convert the bicycle/pedestrian pathways into winter-use pathways. The paths then become cross-country ski trails, horseback riding

routes, snowshoeing, etc. Another important consideration is that a significant portion of the budget for Parks and Recreation[1] is currently spent on sport activities that are of a similar seasonal nature. In comparison, for example, in 1987 there was 339 knock-down hockey pens and pleasure skating rinks erected throughout the six city districts. The total cost was in excess of $710 000 dollars[2] and depending on the weather their use varies between 10 to 12 weeks per year. The cost of operating the outdoor pools in Winnipeg during 1987 was $470 000 for an average season of between 8 to 10 weeks.. The cost of operating Kil-Cona Regional Park golf course in 1987 was $1.1 million dollars. The facility was used by 48 600 golfers over its 200 day season.

According to figures established by the Royal Canadian Mounted Police there was over $110 million dollars worth of bicycles stolen in 1986 across Canada. In Winnipeg alone there was over 5 300 bicycles stolen in 1987. The reasons for the high theft rate is a result of: no easy methods of marking bicycles; bicycles are generally easy to steal; a stolen component cannot be identified unless it is marked; enforcement against bicycle theft is difficult; and, insurance companies readily pay for stolen bicycles. For this reason it is recommended that the city implement a registration system. The identification program would use the owners/parents drivers licence number (allows for quick identification and notification by the police) stamped on each component of the bicycle. A social insurance number may be substituted if no drivers licence is available. The advantages of this system include:

1. Provide information on the numbers of bicycles and locations of highest concentration throughout the city.

2. As the majority of bicycles are stolen for parts, an ID program discourages this practice by marking each part. Resale of these items also becomes difficult for the thief.

3. Use of the drivers licence number as identity marks enables police to determine the owner of the bicycle within minutes. It also provides a tool for the police to assist in identifying the rider of a bicycle or to corroborate the name given by a rider who does not produce identification.

4. The program enables to recognize a stolen bicycle by noting that only one part of the bicycle is marked or that two different marks appear on the same bicycle or other irregularities.

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[1] The budget for Parks and recreation in 1987 was $53.5 million dollars.

[2] Costs included the labour necessary for erecting, maintaining and caretaking as well as equipment, parts, repairs and depreciation.

5 Prospective purchases of used bicycles can have the identification number checked to confirm that the bicycle is not stolen.

6 The recovery rate of stolen bikes is increased, while simultaneously decreasing the number of fraudulent bike theft insurance claims.

A program similar to this was implemented in Cranbrook, B.C. for 2 years and over this time the theft rate was reduced by 40%.

Recreation Trends

During the last few years significant trends have developed in the areas of recreation and leisure which directly influence cycling in Winnipeg. It is of paramount concern that these are addressed to ensure that future recreation planning is maximizing cost effectiveness. The most notable ones include[1]:

- There has been a rapid increase in sports participation by adults (18-35 years old cohort represents 27% of the population). By 1993 the 30-50 year old group will comprise 36% of the Canadian population. This will directly affect recreation and leisure activities into the next century.
- A dramatic increase in the number of women, particularly the 15-35 year old group, in sports and recreational activities like jogging and bicycling.
- There is a shift from competitive sports activities to one of casual fitness or exercise-oriented sports due to the aging society, high costs associated with training for competitive sports, quest for lifelong activities and a desire for self-expression and fulfillment.
- Cross-country skiing currently ranks as one of the fastest growing mass-participation activities.
- Over the last decade participation by seniors in such activities like bicycling has jumped significantly. As the proportion of seniors in the population increases, the provision of recreational opportunities for this age group will become increasingly important.
- In the last ten years, leisure time has increased by 10%.[2] As well there has been a definite trend to recreation activities taking place closer to place of residence thus exerting greater pressures on urban recreation facilities. This proclivity is attributed to a growing awareness of the recreation amenities in large urban areas, rising fuel and transportation costs, the reluctance of people to spend long periods of time travelling to a recreation destination and an increase in leisure time.

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[1] Parks, Recreation and Property Committee. *Ten-Year Concept Plan of Major Recreation Facilities.* Toronto, Ontario: Parks and Property Department. The Municipality of Metropolitan Toronto. 16 November 1983. p.4-6. With the exception of those noted.

[2] "Recreation". *Landscape Architecture Technical Information Series.* Volume 1. No.1. American Society of Landscape Architects. Washington, D.C. p.6.

These trends indicate a gradual but definite shift from traditional, organized, competitive sports to more casual, individual, adult-oriented activities. Recreation is also progressively becoming a year-round activity. Planned facilities are an opportunity for self-fulfillment, socialization, lifestyle enrichment and lend themselves to the recreation patterns of an expanding adult population. As there is a noticeable trend to recreation activities becoming health and family-oriented, and occurring closer to home, recreation facilities located in urban areas will continue to serve even larger segments of the population. Demand for urban recreation facilities will become even more critical with increasing discretionary time, innovative work hours, shortened work week, unemployment, longer vacations and earlier retirement. The City of Toronto has responded to the unprecedented growth in cardiac fitness/exercise activities, such as bicycling, walking, jogging and cross-country skiing by proposing an ambitious plan to expand the amount of bicycle/.pedestrian trails throughout the municipality by 50%.

5.1 SUMMARY

The underlying principle is to develop a Winnipeg Bicycle Plan that would be long-lasting, responsive and directly useful and that would meet the very difficult challenges of planning for bicycles during times of fiscal restrain and on an established roadway system which is not notably "bicycle friendly". The purpose of the plan is to provide for the safe use of the existing system of bikeways and to recommend those facilities needed and programs required within this context. A successful network can only be realized if there is a strong, long-term commitment by area residents and government officials. The potential for cycling in Winnipeg is excellent. The combined elements of a relatively unimpeded roadway grid system, flat terrain, expansive natural park areas, and wide streets form the making of an ideal, future bicycling network.

Evidence is mounting that planning which neglects alternatives to the automobile, will result in detrimental impacts to the quality of life for city residents. This includes the municipality's inability to maintain its roadways and construct new ones; increased traffic congestion; a rise in the level of noise and air pollution; etc. In an era of energy and environmental conservation the bicycle has evolved into an underutilized, inexpensive and beneficial mode of travel. Although current use is at an all time high, indicated by the widespread ownership levels and its present ranking as the number one form of outdoor activity, greater use is inhibited by the present level of service, and safety and security concerns, both real and perceived. The complexities of modern urban society require a system of transportation which would include railroads, buses, private automobiles,

bicycles and pedestrians. Each one of them has its own unique capabilities and requirements, but a successful city transportation system will be one which accommodates all by blending them together.

The bicycle then becomes a component of a new strategy to urban transportation planning. One that moves away from the private automobile with a new focus on alternative modes of travel, like car-pooling transit, and bicycling which help to alleviate the current, urban transportation ailments. Over time every road designed, resurfaced or improved gives full consideration to the pedestrian and bicyclists. Incentives are given to developers who provide facilities for bicyclists and pedestrians and bonuses to employees who walk or cycle to work. Schools encourage students to ride. Efforts are made to plan neighbourhoods, commercial centres, industry, parks and schools to minimize trip length. In time people begin to respect one another as compatible and legitimate roadway users.

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