# THE COSTS AND BENEFITS OF EXCLUSIVE TRANSIT LANES:

# A WINNIPEG CASE STUDY

by

Peter D. Monteith

A practicum
presented to the University of Manitoba
in partial fulfillment of the
requirements for the degree of
Master of City Planning
in
Faculty of Architecture

Winnipeg, Manitoba, 1986

ISBN 0-315-33949-7

# THE COSTS AND BENEFITS OF EXCLUSIVE TRANSIT LANES:

# A WINNIPEG CASE STUDY

BY

PETER DOUGLAS MONTEITH

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF CITY PLANNING

I hereby declare that I am the sole author of this practicum. I authorize the University of Manitoba to lend this practicum to other institutions or individuals for the purpose of scholarly research.

Peter D. Monteith

I further authorize the University of Manitoba to reproduce this practicum by photocopying or by other means, in total or in part, at the request of other institutions or individuals fo the purpose of scholarly research.

Peter D. Monteith

## ABSTRACT

The principles of traditional transportation planning have been concerned with the efficient movement of vehicles. This view is slowly changing and the movement of people rather than vehicles is now seen by many as being of upmost importance. One tool being used to promote this fundamental change in philosophy is exclusive transit lanes. This practicum applys the principles of transit priority measures and more specifically exclusive transit lanes to an actual urban roadway,Portage Avenue in Winnipeg.

The practicum uses both precedence and actual field work to predict the effect of the transit lane on transit operations.Precedence showed that in many cases transit lanes have been successful in giving buses an operating environment in which they can run more efficiently. As well, the field work determined that the conditions along Portage Avenue are conducive to the implementation of a transit lane, and that savings in both terms of time and money could be achieved. In order to simulate the operating environment of the exclusive transit lane, the Transit Lane Simulation Model was developed. The test results showed that a with-flow lane implemented along Portage Avenue between Main Street and Sturgeon Road would produce significant time savings resulting in monetary savings for the transit system.

**ACKNOWLEDGMENTS**

In any exercise of this magnitude a team effort is important, as a result I think it is appropriate to thank "my team".

First of all I would like to thank my advisor,Professor Basil M.Rotoff for all of his invaluable advice and patient reassurance.

Secondly, I would like to thank my two readers, Professor Geoffry Bargh and Mr. Kent Smith who gave me support and encouragement along the way.

Thirdly, I would like to thank Peter Hague of Winnipeg Transit, Peter Walton of the Province of Manitoba and Dave Green of the City of Winnipeg who took an interest in the research and offered me their advice.

And finally I would like to thank the Center for Transportation Studies at the University of Manitoba for their generous financial support and to the Province of Manitoba, Department of Urban Affairs for their moral support.

As well, it is important to thank those at home who helped to provide a happy life away from work, as a result this practicum is dedicated to, Mary, Natalie and Thomas Monteith.

# CONTENTS

## FIGURES

## TABLES

## Chapter I

## INTRODUCTION

> Urban transportation planning is, today, in a transition state. It is still attempting to meet the public's desire for mobility and at the same time provide desirable alternatives to the automobile.[1]
>
> --John S. Hassell

### 1.1 Purpose

In the last 25 years there have been at least three proposals to introduce a rapid transit line to the Portage Avenue corridor. There are many reasons why these projects were never initiated, but perhaps the main consideration has been cost. Recent rapid transit projects have revealed that the construction costs have ranged from $40 million per kilometre for both the Vancouver Automated Light Rapid Transit System and Toronto's Bloor subway extensions to $16 million per kilometre for Calgary's light rapid transit lines.

**The purpose of this practicum is to determine the utility of an exclusive transit lane on Portage Avenue.** The advantage of such a system over the rejected projects is clearly

[1] John S. Hassell, "How Effective Has Urban Transportation Planning Been", in URBAN TRANSPORTATION PERSPECTIVES AND PROBLEMS, editor Herbert S. Levinson, Westport: Eno Foundation For Transportation, 1982, p.13

the capital cost saving. The implemention costs of a transit lane on a existing street for example, is estimated to be only $12,000 per kilometre, considerably less than rapid transit implementation costs.[2]

## 1.2 Methodology

The research involves five basic methodological steps, they are:

1. Investigation- a search of the existing literature was made to
   - rationalize the need for transit, and to determine if transit deserves priority over automobiles.
   - look at the record of transit lanes already in existance to see if there are any lessons to be learned.
2. Observation-observe the existing transportation conditions on Portage Avenue.
3. Assessment- assess the need for a transit lane in light of the present conditions.
4. Simulation- simulate the operating environment of an exclusive transit lane in order to properly predict the effect of the lane on transit system operations.
5. Comparison- compare the two transit lane alternatives and determine which is more applicable to the Portage Avenue situation.

---

[2] IBI Group, RESERVED TRANSIT VEHICLE LANES AND TRANSIT PRIORITY MEASURES, Toronto:Toronto Transit Commission, 1982, p. 26

Before a project such as this is contemplated it is important to first answer a few basic questions.

The first question that must be asked is, does transit deserve priority over automobiles? This most basic question must be answered as the entire strategy rests on the assumption transit is an essential service and deserves priority over automobiles. This question is addressed by analyzing the costs and benefits of both automobiles and transit.

Once it has been determined that transit is an essential service, it is then important to see how transit lanes have been implemented in other cities. In order to do this properly, the justification for implementation must be examined and the performance of the transit lanes evaluated. For example the minimum lane utilization warrants developed by various agencies are an important evaluation criterion.[3] These warrants are a good tool for determining if the level of transit service and patronage is high enough to consider the removal of a lane from the general traffic flow. Precedence is also an important factor to consider. Although every traffic corridor is unique, there are still lessons to be learned from other centres. The examples have been chosen for their diversity, and illustrate both successes and failures.

---

[3] Minimum Lane Utilization Warrants refer to a minimum level of transit traffic and patronage required to justify the implementation of an exclusive transit lane.

The third issue deals with the applicability of a transit lane for Portage Avenue. This requires the cataloging of the traffic conditions as well as the level of transit service in the area. These conditions will then be compared to the minimum lane utilization warrants to determine if transit lanes are justified.

If it is determined that transit lanes are justified, it is then important to find some way of projecting the impact of the transit lane on the transit system and to determine where the transit lane should be located. This will be done by observing the operation of buses on Portage Avenue, and then incorporating this information into a transit lane simulation model. The purpose of this model is to simulate the operating conditions of a transit lane without actually implementing the scheme. This is done by eliminating the effect of congestion on buses while keeping other variables such as traffic light delay times and passenger loading times constant.

Since the potential results of the with-flow lane and contra-flow lane are different it is important to compare the costs and benefits of each option. The two options which will be explored in this practicum are curb lane with-flow lanes and median lane contra-flow lanes.[4] The evaluation of options will be determined by looking at the following factors; travel time savings, travel time regularity,

---

[4] The term contra flow lane refers to transit lanes which run against the general traffic flow.

capital costs, operating costs, impact on commuters in adjacent lanes, accessibility of bus stops, adaptability of transit lane to accommodate different levels of bus routes and response of municipal bureaucrats.

## 1.3 Synopsis

The practicum will flow from a general discussion of the benefits of transit and the need for transit priority to a gradually more site specific discussion of the ramifications of implementing a transit lane on Portage Avenue.

The second chapter will make a case for transit and look at a few issues facing transit systems such as declining revenues and rising costs. The relationship between automobiles and transit systems will also be addressed and it will be determined if transit is a public service. Chapter Three will look at the rationale for transit priority with special attention being paid to exclusive transit lanes. As well, the record of a few existing transit lanes will be looked at to see how these lanes work in reality. Chapter Five will introduce the study area, and assess the two options in the context of the actual transportation conditions of Portage Avenue. This will be done by simulating the effects of the transit lane and estimating the effect of the transit lane on transit operations. The sixth chapter will summarize the findings of the research and recommendations arising from the research will be made.

## 1.4 Orientation

The practicum will follow a pro-transit direction,this means essentially that transit is viewed as an important municipal service and as such should be promoted. For the most part, the practicum is limited to local transit improvements and is very specific. While some of the methodological steps could be transferred to other transit lane schemes, for the most part the research is very site specific.

The practicum is approached from both a social science and planning perspectives, and accordingly will look at both the technical and social aspects of transit.

It is important to note that this practicum is being undertaken in consultation with the Province of Manitoba, Department Of Urban Affairs, and is tailored to their needs. Since this department"s involvement with such a project will take the form of complementary funding, the direction of this practicum is more concerned with assesing the overall costs and benefits of the project rather than focusing on the actual implementation process.

# Chapter II

## INTRODUCTION TO TRANSIT SYSTEMS

> The automobile society is the result of one-dimensional thinking, leading to the belief that the principle purpose of existence is not better life but longer cars to move us greater distances at higher speeds.
>
> --Lewis Mumford

### 2.1 Introduction

Before any discussion of transit priority measures can take place, the characteristics of transit service must first be explored. This chapter will provide such an introduction. The chapter will examine the many aspects of transit service, such as the performance, types of service, and demand for transit service. The second section will compare transit service to the use of the automobile trying to determine if transit is indeed a public service, and worthy of some type of priority status over the automobile.

### 2.2 Recent Trends In Transit Operations

During the past few years many changes have taken place in the transit industry. These changes have affected all aspects of transit operations, including technology, type of ownership, level of ridership and financial viability.

Transit technology has evolved from the use of the omnibus in the 17th century to state-of-the-art automated light rapid transit, such as the system just opened in Vancouver. Even with innovations such as this, the primary technology used by transit systems is the diesel bus. In Canada, for example, 80 percent or 10,398 of the 13,058 vehicles which made up the 1983 Canadian urban transit fleet were buses. This is up from the 52 percent or 3,933 out of 7,506 vehicles of the 1950 fleet.[1]

The next most common form of transit vehicle is the heavy rail vehicle followed by trolley coaches and light rail vehicles. It is interesting to note that since 1955, when heavy rail vehicles were introduced into the Canadian urban transit fleet, the number of vehicles has increased from 100 to 1,435. On the other hand both light rail vehicles (LRVs) and trolley coaches (electric powered buses) have declined in number since 1955.[2] This is due to the phasing out of streetcars in every city with the exception of Toronto. It must be noted however that since 1983, Edmonton, Calgary, Vancouver and Mississauga have introduced LRV service. Trolley coach service like LRV service has also declined. In 1960 for example, there were 1,185 trolley coaches in service while in 1983 the total had fallen to 649.[3] Again

[1] Canadian Urban Transit Association, URBAN TRANSIT FACTS IN CANADA 1984 EDITION, Toronto: Canadian Urban Transit Association, 1984, p. 33

[2] CUTA, URBAN TRANSIT FACTS IN CANADA, p.33

[3] Ibid, p.33

much of this reduction is due to transit systems phasing out trolley coach service. In fact only Toronto, Hamilton, Edmonton and Vancouver still offer this type of service. In the United States the motor bus is the most commonly used type of transit vehicle, although the number of buses in service has declined since the late 1940's.[4]

The trends in the size and composition of the Canadian urban transit fleet reflect the ridership trends. In 1955 for example, there were 33 transit systems which served urban areas with a combined population of 5,666,000. These systems carried 1,395,671 passengers for a rides per capita ratio of 246.32. By 1983, 74 transit systems serving urban areas with a combined population of 13,845,000 only carried 1,385,710 passengers. As a result the rides per capita ratio has fallen to 100.09.[5]

These ridership trends have resulted in severe financial difficulties for transit systems for as ridership has been decreasing, the cost of providing this service have been going up. The relationship between costs and revenues is well illustrated by the revenue cost ratio. In 1950 this ratio was 1.137 which meant revenues more than covered the cost of providing the service. By 1983 however, the ratio had fallen to only .534, only slightly more than 50 percent of the cost of providing the service. This cost recovery is

[4] Richard Soberman and Heather A. Hazard, CANADIAN TRANSIT HANDBOOK, Toronto: University of Toronto-York University Joint Program in Transportation, 1980, p.20

[5] CUTA, URBAN TRANSIT FACTS IN CANADA, p.31

of course subject to local conditions,as a result the recoveries ranged from 23 percent to 71 percent of costs.[6]

Another way of comparing revenues and costs is to look at the relationship between revenues and expenses on a per kilometer basis. Up until 1970 the revenue per kilometre was always higher than the cost of providing the service. In 1971 the first year expenses exceeded revenues the difference between the two was only 4 cents per kilometre (60 cents versus 64 cents). By 1971 this gap had grown to 62 cents per kilometer (71 cents versus $1.33), while in 1983 the gap was $1.07 ($1.30 versus $2.37).[7]

There are basicly two reasons why the costs of providing transit service are now exceeding revenues. Firstly, the cost of servicing the expanding suburban areas are much higher than those incurred for inner city service. John Sewell noted:

> The effect of serving suburbia has been dramatic, and in six short years (1970-1976), the TTC deficit has jumped from nil to $56 million per year. The deficit is a direct result of attempting to provide transit service to the suburbs.[8]

And, secondly, cost of providing this service is growing faster than the costs for other services. The Institute of Traffic Engineers of the United States noted that:

---

[6] CUTA, URBAN TRANSIT FACTS IN CANADA, p.32

[7] Ibid, p. 29

[8] John Sewell, "The Suburbs" in CITY MAGAZINE, Volume 2, Number 6, January 1977, p.45

> the full cost of operating a vehicle mile of transit service rose over twice as rapidly as did both the full cost of driving an auto and the consumer price index nationwide.[9]

This helps to explain the financial constraints transit systems must operate under. It has been determined that transit prices are inelastic, which essentially means that drastic increase in fares will result in a reduction of ridership, which of course adds to the cost per ride. As a result transit systems are under pressure to keep their costs to a minimum while maintaining present service levels. Transit has been recognized as a public service, as a result government has become involved in its operation, directly through municipal ownership, and indirectly through government subsidies. As a result, all major transit operations are municipally owned, and seven out of ten provinces subsidize urban transit systems.

## 2.3 Transit Technologies

The precedeing section looked at transit in general terms, and the trends reflect the performance of all transit systems regardless of mode. Soberman and Hazard in the CANADIAN TRANSIT HANDBOOK stated that, "transit modes can be classified according to their technologies, basically a set of physical attributes that describe the supporting way (or guideway), vehicles and power supply."[10]

---

[9] John Baerwald, TRANSPORTATION AND TRAFFIC ENGINEERING HANDBOOK, Englewood Cliffs: Prentice Hall Inc., 1976, p. 245

There are basically five modes of transit vehicles: motor buses, trolley coaches, light rail vehicles, heavy rail vehicles, and commuter rail vehicles. Of these technologies, only motor buses are used in Winnipeg.

There are many different types of buses which can be used. Winnipeg Transit operates both 40 foot buses, with a capacity of 100 persons (sitting and standing) and 30 foot buses which have a capacity of 70 persons (sitting and standing).

Motor buses of course operate on the same road system as do automobiles and trucks. There are both advantages and disadvantages associated with such a system. Trevor Price of the University of Windsor stated that:

> "The bus will continue to be a significant mainstay of any transit network because it has flexibility and relatively low capital investment. It does not need its own right-of-way or costly stations."[11]

The flexibility of buses as noted by Professor Price is perhaps one of the most important attributes of a bus system. Unlike fixed systems, bus routes can easily be modified to adapt to any change in demand. This view was shared by Christian G. Kling who stated that, bus transit's advantages over other forms of transit is "if a planning error in assesing or forecasting route demand is made, the bus route can easily be changed. Needless to say, this is not the

---

[10] Hazard and Soberman, CANADIAN TRANSIT HANDBOOK, p.53

[11] J. Alex Murray, MASS TRANSIT: THE URBAN CRISIS OF NORTH AMERICA, Windsor: Canadian American Seminar, 1976 p. 259

case once mass transit lines are constructed."[12]

The fact that buses share the same right-of-way with other vehicles is also a disadvantage, as the bus is continually hampered by congestion. This congestion which slows down the buses, affects the regularity of service, which can of course affect patronage.

## 2.4 Types Of Service

Soberman and Hazard further qualified their classification of transit operations. They recognized that within any transit technology, different types of service can be provided. The type of service relates to "such variables as frequency of service, hours of operation, stop separation, and route structure."[13] Based on this criteria there are basically two types of bus service, express and local. However, before one can look at the characteristics of these types of services it is important first to address and define the above variables, and to determine how they affect service.

The first variable, frequency of service or headway, refers to the amount of time between each bus at a given point. The headway is of course affected by many other factors such as patronage, type of vehicle, performance, and vehicle speed. In most economic ventures, demand will

---

[12] Christian G. Kling, URBAN TRANSPORTATION, PROBLEMS AND PROSPECTS, New York: Vantage Press, 1976, p. 64

[13] Soberman and Hazard, CANADIAN TRANSIT HANDBOOK, p. 53

determine supply. However transit is recognized as a public service, and in order to provide this service strict supply and demand theory does not always apply, as many uneconomic routes are maintained.[14]

In most cases there are two sets of basic service headways for a given route, one for peak commuting periods and one for off-peak. The headway is an important consideration when one is choosing mode of travel. Boris Pushkarev noted this importance:

> peak hour headways longer than 6 minutes are deemed by operators to be unacceptable to the passenger in more than 90 percent of the cases, and those longer than 7.5 minutes in all cases.[15]

While headways are not particularly a problem for those who plan their trips and know the schedule, they are a problem for those who take spontaneous trips, and do not consult the schedule. This problem is worse in the non peak periods when the headways are always longer. Pushkarev again noted:

> "a 7.5 minute headway during the peak may translate into a 15-20 minute headway in midday or evening hours. This is not an attractive service for spontaneous, walk-in traffic.[16]

A bus system with a proper length headway can help to provide a well balanced transit system. In this case balance means a system which is not overcrowded or empty.

---

[14] The reasons why transit is seen as a public service will be discussed later in the chapter.

[15] Boris S. Pushkarev, URBAN RAIL IN AMERICA, Bloomington: Indiana University Press, 1982, p. 55

[16] Ibid, p. 55

The hours of operation vary with the system. In Winnipeg, for example the buses operate from approximately 6:00 a.m. to 1:00 or 2:00 a.m.

Stop separation refers to the distance between bus stops. According to the Institute of Traffic Engineers (ITE) the minimum distance between stops should be between 122 and 243 metres in the CBD for local bus service and 152 to 304 metres for express services. Outside the CBD these spacings are generally increases to between 152 and 243 metres for local, and 1,216 and 9,120 metres for express bus service.[17]

As expected, the spacing of bus stops directly affects the travel time of transit vehicles, as more stops increase the travel times of the buses. A recent study by Winnipeg Transit revealed that travel time in the peak periods is increased by 13 seconds for every bus stop located along its routes.[18]

Stop separation also has an effect on patronage as most people are only willing to walk short distances to the bus stop. The CANADIAN TRANSIT HANDBOOK noted:

> it can be assumed that 50 percent of all transit users will walk less than 150 metres and that only a very few will walk more than 600 metres.[19]

---

[17] Baerwald, TRANSPORTATION AND TRAFFIC ENGINEERING HANDBOOK,p. 220

[18] Interview with Peter Hague, Transit Department, City of Winnipeg, Winnipeg Manitoba, 3 January 1985.

[19] Soberman and Hazard, CANADIAN TRANSIT HANDBOOK, p. 125

As a result it is evident that the spacing of bus stops not only affects the speeds obtained by transit vehicles, but also effects the level of patronage by noncaptive riders.[20]

The first type of service, as earlier noted is referred to as local routes. The I.T.E. defines local bus routes as follows:

> Local routes operate along the surface of city streets with stops spaced approximately one or two blocks apart and serving entirely within one urban area . . . . local routes usually provide the basic and preponderant transit service in an urban area.[21]

Local routes usually carry out a number of functions in a transit system. They are used both as feeder or line haul routes. A feeder route, is service which runs through a residential neighborhood, picks up passengers and deposits them at transfer points where the patrons can then transfer to line haul routes that carry the patrons along major arterial streets to the CBD. Since some people only make short trips along arterial streets, local services is also offered along these routes to provide more local service than express service offers.

The second form of bus routes is the limited stop or express routes. These types of routes are used on longer routes to help shorten the travel times. In most cases this

---

[20] The term captive rider refers to those with no other transportation option.

[21] Baerwald, TRANSPORTATION AND TRAFFIC ENGINEERING HANDBOOK, p. 227

service complements local service, so both levels of service are offered.

The ITE defines limited and express routes as follows:

> limited stop service usually involves operation along city streets with stops mainly at major transfer points beyond the CBD. Express service involves even faster operation with fewer stops than limited service.[22]

This level of service is provided to ensure the fastest possible service between two points (in most cases between the suburbs and the CBD). By shortening the travel time it is hoped that more riders will be attracted, while making the operation more efficient.

## 2.5 Demand Characteristics

Demand for transit service varies on a monthly, daily and hourly basis. As a result, transit schedules often mirror these variations in demand, and different levels of service are offered in response to these fluctuations. An analysis of seven transit operations in the CANADIAN TRANSIT HANDBOOK indicates that these variations are common to all systems, and are relatively consistent one with another. On a monthly basis the winter months usually have the highest transit demand with the demand declining steadily from March to August, and then again rising as the weather becomes colder.[23]

---

[22] Ibid, p. 227

[23] Canadian Urban Transit Assoc, and Roads and Transportation Association of Canada, CANADIAN TRANSIT HANDBOOK (2nd ed), Toronto: CUTA and RTAP, 1985, p. 4-24.

On a daily basis, the demand for transit is fairly stable during the week, with any increase in demand taking place on Fridays. There is a substantial reduction in demand for transit service on the weekends, because of the lower number of work trips.

Hourly, there is quite a variation in the demand for transit, and this again is the result of hours of employment. The CANADIAN TRANSIT HANDBOOK states that trips to work account for 43 percent of all urban travel.[24] As a result demand peaks in two commuting periods, usually 7:00 to 9:00 and 15:00 to 17:00. In these periods the demand is such that, "capacity must be provided for as much as four or five times the average demand rate."[25] To illustrate this demand a comparison of vehicles operating in peak and non peak hours is useful. In 1982, 10,560 vehicles operated in the peak periods in Canadian cities, compared to 4,742 vehicles in the non peak hours. In cities, the size of Winnipeg the difference is 2,084 buses in service in the peak to 1,001 in the non peak hours.[26] What this means to the transit system is that essentially half of the fleet sits idle for most of the day. In terms of labour it means that most of the drivers must work some sort of split shift in order to handle the peak demand ridership.

---

[24] Ibid, p. 4-22

[25] Ibid, p. 4-22

[26] Ibid, p. 3-8

Transit demand is also affected by more personal factors such as location of home and work, income, age, and disability. In many cases transit is not a feasable mode of travel due to distance from routes, while automobile flows are fairly equally distributed throughout the street system reflecting the flexible nature of the automobile. The same however, can not be said for transit demand. Most transit demand is for trips in and out of the CBD, as a result the routing reflects this fact. If one is to make a trip that does not follow this general pattern, it is more difficult and time consuming to use transit. This fact was well illustrated in a study of national commuting patterns in the United States undertaken by Guest and Chuett. They found that work trips from the suburbs to the CBD had a transit work trip mode split of 11 percent,while the mode split for work trips within the suburbs was only 1.8 percent.[27]

As level of service often mirrors demand, it means that service between points in the suburbs is often minimal. As a result, the automobile is often used for trips of this nature.

Income, age, and disability often determine if a person is a "captive" or a "non captive" rider. A non captive rider is one who has the use of an automobile but chooses for whatever reason to utilize transit. On the other hand,a captive rider is one who must use transit as he or she can-

[27] A. M. Guest and C. Chuett, "Analysis of Mass Transit Ridership Using 1970 Census Data," TRAFFIC QUARTERLY, Vol. 30, No.1 , January 1976, p. 150

not or will not use an automobile. In general, a majority of transit users are captive riders. This is well illustrated by the makeup of transit patrons in both Pittsburgh and Chicago. In these cities it was estimated that 85 percent of transit patrons in Pittsburgh and 65 percent of patrons in Chicago either had no drivers license or no automobile.[28] The effect of income on transit ridership is dramatic, as income is usually a determining factor in ability to own an automobile. A comparison of modal split by income for Mississauga Transit in 1977 revealed that 63.6 percent of all trips by transit were made by persons from a family with a household income of less than $5,000 per year,while for families with an income over $40,000 a year the level was only 1.6 percent.[29]

Age and disability have obvious effects on patronage as some people are unable to obtain a drivers license. In Manitoba, for example persons under 16 years of age are unable to obtain a drivers license. As well, many elderly persons are unable to safely operate a motor vehicle.

Physical disabilities can effect patronage two ways. In some cases persons with severe ambulatory disabilities are unable to ride transit because they have no access to it. In some cases these persons are offered some type of parallel service. Persons not severely enough disabled to uti-

---

[28] John B. Rae, THE ROAD AND THE CAR IN AMERICAN LIFE, Cambridge: The MIT Press, 1971, p.215

[29] CUTA NTAP, CANADIAN TRANSIT HANDBOOK p. 4-30

lize this service, but too disabled to operate a motor vehicle are obliged to use transit as a means of mobility.

The difference between "captive" and "non-captive" riders is important to note as any increase in patronage will often have to come from the latter as captive riders for the most part already utilize transit.

## 2.6 Transit Versus The Automobile

It has become apparent that the increasing number of automobiles in our cities has created many problems. For many years, the automobile was seen as positive force in the city, but, this view is changing. Ronald Fisher of the National League of Cities stated that "only recently has the United States recognized that the automobile is strangling its cities and that something must be done to relieve the situation."[30] This sentiment although shared be others, has not diminished the popularity of the automobile.[31]

Not all people involved with urban transportation share the view that automobiles are stifling our cities. Wilfred Owen for one believes that automobiles perform a very valuable service. He stated :

> cities and automobiles are not in conflict, but are methods of achieving the same human purposes. They both contribute to man's freedom and to his

---

[30] National League of Cities, TRANSPORTATION AND THE URBAN ENVIRONMENT, Washington: U.S. Department of Transportation, 1979, p. 5

[31] This dilemma was the theme of a Organization For Economic Cooperation and Development (OECD) Conferance in July 1979.

freedom of choice."[32]

### 2.6.1 Benefits Of The Automobile

There are many benefits for the individual associated with the use of the automobile, and it is a combination of these benefits that makes the automobile so attractive. A 1973 survey of German commuters determined why a majority of commuters use automobiles rather than transit. Terence Bendixson summarized their responses:

> they said (the motorists) they knew that buses, trains, and undergrounds were cheaper and safer than cars but they also thought them to be noisier, dirtier, slower and to offer less freedom of action and less comfort.[33]

#### 2.6.1.1 Convenience

The first factor is convenience, as noted earlier, buses run along particular routes, and for the most part, these routes do not correspond to the exact trip required. The result is a walk to and from the bus stop at each end of the journey, while in some cases a transfer from one vehicle to another is needed. The automobile on the other hand offers virtual door-to-door service.

---

[32] Wilfred Owen, THE ACCESSIBLE CITY, Washington: The Brookings Institute, 1972, p.2

[33] Terence Bendixson, INSTEAD OF CARS, London: Temple Smith Ltd., 1974, p. 14

#### 2.6.1.2 Passenger Comfort

The second benefit relates to passenger comfort and vehicle design. Automobiles are consumer items, and many contain comforts such as adjustable seating, radio, heat, and air conditioning. Buses, on the other hand are built to be functional. The result is seats (when available) that are relatively uncomfortable, and a ride that is not as comfortable.

#### 2.6.1.3 Flexibility

The third benefit deals with the freedom or flexibility of the automobile. With an auto one can travel any time and not be restricted by a schedule. As well, one can travel to virtually any destination. Wilfred Owen wrote:

> A car is a means of escaping the city, of finding a home where land is less costly, and of expanding the opportunity to find a job.[34]

From this perspective it appears the automobile not only expands freedom of travel but freedom of choice as well for the location of housing, workplace, and recreation.

#### 2.6.1.4 Privacy

The fourth advantage of the automobile is the privacy it gives the commuter. It is commonly believed that individuals possess a psychological need for personal space. The automobile caters to this need as one can travel in a relatively private world. The same is not true for public transit. At some times, especially during peak periods, transit

[34] Owen, THE ACCESSIBLE CITY, p. 6

vehicles are extremely crowded. As a result some patrons are forced to stand in close proximity to others. This overcrowding, while economically efficient for the operators, discourages ridership.

The fact that automobiles are so popular suggests that people place a high value on these benefits when choosing a mode of travel.

### 2.6.2 Benefits Of Transit

The precedeing sections have shown that automobiles offer the individual a high level of service. It has also been determined that transit operations are expensive and often require a form of government subsidization. This section will illustrate that even in light of these facts, transit provides an important service in our cities, and warrants governmental support. There are basically six benefits associated with transit service: alleviation of traffic congestion, mobility and access for those without automobiles, energy efficiency of transit vehicles, environmental factors, land-use considerations, and highway safety. Each of these factors will be addressed in turn.

#### 2.6.2.1 Alleviation Of Traffic Congestion

All inhabitants of a large city have experienced some form of traffic congestion. A major cause of congestion is the inefficient nature of the automobile. One lane of a city street has a capacity of 600 vehicles per hour. Even with a average vehicular occupancy of 2 persons (which is above the average for most cities) this lane only carries 1,200 commuters per hour.[35] If that same lane however, was only utilized by 60 buses, the capacity of the lane would rise to between 3,720 and 4,500 commuters an hour.[36]

As a result, the use of transit by commuters lessens the number of automobiles on the road and helps to alleviate congestion. A study undertaken by the Toronto Transit Commission determined that each bus in its system replaced 188 cars each day, and that without the transit system an additional 30,000 cars would be on the roads each day in Metropolitan Toronto.[37] There are many costs associated with congestion, not only to the individual, but to society as well. Increased usage affects the financial costs of both automobile and transit users, but in different ways. This difference is outlined by Kling who stated:

> a transit system is a decreasing cost system. As you add riders, it becomes cheaper to operate. In contrast the private auto is an increasing cost system. As you add riders, it costs more to operate the system.[38]

In other words, as the number of automobiles increases the response of urban government is to expand the street system, thereby increasing the capacity of the roadway. The costs of accomodating these automobiles is enormous. Hans

---

[35] Kling, URBAN TRANSPORTATION PROBLEMS AND PROSPECTS p. 49

[36] Ibid, p. 49

[37] CUTA, URBAN TRANSIT FACTS IN CANADA,p. 69

[38] Ibid, p. 46

Blumenfeld in an essay on transportation noted that "a capital investment of $25,000 is required to enable one additional commuter car to come to downtown Washington D.C."[39] He then added that it was likely that these costs would be the same in other urban areas. This concept of putting a cost on congestion was shared by Wilfred Owen who wrote that "every motorist driving into the central business district of New York during rush hours in 1972 was costing the city $500 a year."[40] This of course does not take into account the frustrations and time loss associated with traffic congestion. In response to these frustrations Ada Louise Huxtable wrote:

> To survive in Manhattan, so goes the advice, make no crosstown trips at lunchtime, no appointments before 11 or after 3, no subway trips except in non peak hours, and no friendships beyond walking distance.[41]

While one may not have to be as cautious in many Canadian cities, there is no doubt one takes traffic conditions into consideration when planning a trip in any urban centre.

The congestion caused by automobiles provides a serious problem for transit systems as transit is locked into its route, and cannot change routes when a particular roadway is congested.

---

[39] Hans Blumenfeld, THE MODERN METROPOLIS, Cambridge: MIT PRESS, 1972, p. 140

[40] Owen, TRANSPORTATION FOR CITIES, P. 34

[41] Ada Louise Huxtable, "In New York, A Losing Battle" NEW YORK TIMES, December 30, 1969, p. 18

#### 2.6.2.2 Mobility

The second factor, mobility, is essentially a social consideration. A good transit system not only provides the commuter a choice of modes in the case of non-captive riders but also gives the captive riders a greater choice of area of residence or work. Good transit service allows these people to live in areas that would otherwise be inaccessible.

Many Canadians do not have access to an automobile for private use. In 1981 the Canadian Urban Transit Association (CUTA) estimated that 20 percent of urban households in Canada do not own automobiles.[42] In Europe, the figure is even higher, with the carless figure in 1974 being between 40 and 60 percent[43]

The problem is compounded, when one realizes that even in a household with an automobile, the use of a car is not always possible. It was estimated in 1975 that 47 percent of the population of the United States did not possess drivers licenses.[44] Also, the increasing number of two working households with only one car means one may have to use transit. Even with statistics such as this it is hard to determine the real level of need. A good measure is the comparison of work trip data. In Winnipeg, a study undertaken by the City of Winnipeg Streets and Transportation Department

[42] CUTA, URBAN TRANSIT FACTS IN CANADA, p. 5

[43] Bendixson, INSTEAD OF CARS, p. 37

[44] Schaeffer and Sclar, ACCESS FOR ALL, p. 104

in 1981 determined that 58.3 percent of the daily work trips were made by persons who were transit captive.[45] This statistic really illustrates the need for good transit service, as without it these people would be forced to either relocate closer to their place of employment or quit their jobs altogether.

#### 2.6.2.3 Energy Efficiency

The third advantage of transit relates to energy consumption. The concern over the finite nature of the world's petroleum supplies is a fairly recent phenomenon. It was not until the Organization of Petroleum Exporting Countries (OPEC) imposed an oil embargo on western countries in 1973 that energy conservation became an important issue. Transportation systems are a very heavy user of petroleum. In 1982 it was estimated that transportation uses accounted for 25 percent of all energy consumed in the United States.[46] In a comparison of automobiles and transit vehicles it was found that a well utilized transit system is much more energy efficient than automobiles. A 1981 CUTA study backed up this assessment. The study determined that it took 4,311 British Thermal Units (BTUs) per passenger kilometre to move 1.3 persons in a automobile, while only 542 BTUs per passen-

---

[45] City of Winnipeg, TRAFFIC ZONE ATLAS 1981, Winnipeg: Streets and Transportation Department, 1984, p. V

[46] Wilbur S. Smith, "The Energy Crisis Today: A Perspective, in URBAN TRANSPORTATION PERSPECTIVES AND PROBLEMS,editor Herbert S. Levinson, Westport: Eno Foundation For Transportation, 1982, p.80

ger kilometre were needed to move 40 persons in a bus.[47]

In terms of actual gasoline consumption, CUTA made an interesting observation:

> Transit systems carry 15% of all persons travelling to and from work yet used less than 2% of all diesel fuel consumed in Canada. Had these trips by transit been made by automobiles, an additional 6.1 million barrels of petroleum would have been required.[48]

It is obvious that the use of transit by commuters plays an important part in producing large gasoline savings on a national basis. As well, it must be noted that as gasoline prices rise the financial benefit to the individual will also increase.

#### 2.6.2.4 Air Quality

The fourth benefit of transit is the reduction in air pollution associated with reduced automobile use. The cost of automobile emmisions to the individual and to society as a whole is hard to determine. One estimate had the damage to property from air pollution in the United States estimated at $11 billion per year. Of this total 60 percent was attributed to the automobile.[49] From a local perspective it was determined by The Citizens For Clean Air in New York City that "the added social cost per vehicle entering the city are estimated at $2.00 per day or $730 per year."[50] It

[47] CUTA, URBAN TRANSIT FACTS, p.6

[48] Ibid, p.5

[49] Owen, THE ACCESSIBLE CITY, p.46

[50] COMP, MUNICIPAL PERFORMANCE REPORT, Volume 1, Number 6,

must be noted that it is difficult to measure accuratly the long term effects of air pollution not only to one's health but to the environment as well. As a result any estimation of the costs of air pollution must be viewed as being conservative. A comparison of the emissions per passenger mile for buses and automobiles was carried out by CUTA in 1981. This study noted that, "transit buses produce 1/6 the amount of nitrogen oxides, and 1/12 the amount of carbon monoxides."[51]

#### 2.6.2.5 Land-Use

The fifth benefit of transit is the reduction in the need for transportation infrastructure such as roads and parking garages. As stated earlier, the traditional response of municipal governments to roadway congestion has been to expand the road system. As well, more automobiles commuting to the central business district translates into demand for more parking garages. The result is central business districts dominated by asphalt. Terence Bendixson recognized this fact and compared the percentages of land uses in the downtowns of nine United States cities. The results of this study showed that the percentage of streets and parking land use ranged from 35 percent in Chattanooga to 59 percent in Los Angeles.[52]

---

1975, p.20

[51] CUTA, URBAN TRANSIT FACTS IN CANADA, P.8

[52] Bendixson, INSTEAD OF CARS, p.36

There are of course costs associated with high automobile usage in cities. Firstly, there is the cost of constructing and maintaining the street system which can put a strain on municipal government finances. Secondly, valuable urban land which must be used for roads or parking is either not taxed in the case of roads or under-taxed in the case of garages. This under utilization of valuable land is apparent when one considers that it has been estimated that an automobile parked in downtown Toronto is occupying $30,000 to $40,000 worth of land.[53]

The promotion of transit on the other hand can actually help the municipal government's financial and land-use planning. In larger centres for example it was found that the construction of rapid transit lines has lead to development in these corridors. These corridors could now be developed to a greater extent as they were now accessible to more people. A good illustration of this is the Yonge Street subway line in Toronto As a result of this line it was found that:

> From 1952-62, 90% of all office construction in the city took place in the Yonge Street corridor. In the same period, tax revenues in districts adjacent to the Yonge Street subway increased 45% in the downtown and 107% in areas further north compared to 25% for the rest of the city.[54]

Although smaller centres can not contemplate such outlays for transit, it is still felt that providing good transit service can have positive land-use effects. For example,

---

[53] Kling, URBAN TRANSPORTATION, PROBLEMS AND PROSPECTS, p.26

[54] CUTA, URBAN TRANSIT FACTS IN CANADA, p.6

transit service can be a good tool for directing development to particular areas. As well, transit service oriented to the downtown can influence people to utilize the downtown and keep the downtown vibrant.

## 2.7 Conclusion

It has been shown that buses are still the most common form of transit vehicle in service today. The fact buses share the roadways with automobiles can be viewed in either a positive or negative way. Operating on the roadway gives buses a degree of flexibility unattainable by other modes of transit vehicles. This greater flexibility does not come without costs however. The growth in the use of automobiles over the last 30 years has resulted in greater congestion on our roads. This congestion has effected the performance of buses which in turn has made buses less attractive,resulting in declining ridership levels.

Transit provides a valuable public service, as such the use of transit should be promoted and consideration given to modifying the environment buses operate in. The next chapter will investigate one way in which the operating environment of buses can be improved through the use of exclusive transit lanes.

## Chapter III

## EXCLUSIVE TRANSIT LANES

> High performance urban expressways are very much like toilets. They work perfectly fine as long as you don't try to shove too much through them at one time.[1]
>
> --Martin Wohl

### 3.1 Introduction

The need for transit priority measures stems from the fact transit vehicles are more efficient movers of commuters, and accordingly deserve some type of priority over the automobile. Exclusive transit lanes are one form that transit priority can take.

This chapter will look at the rationale, costs and benefits, and examples of both with-flow and contra-flow transit lanes. It is important to remember that buses and automobiles share the roadway, as such the relationship between these two modes must be noted. This relationship is best investigated two ways. The first method is to look at minimum lane utilization warrants. These warrants are used to determine if the level of transit ridership is high enough

[1] J.R. Meyer, J.F. Kain and M. Wohl, THE URBAN TRANSPORTATION PROBLEM, Cambridge: Harvard University Press, 1965, p.104

to justify the closing of a lane to general traffic.

## 3.2 Rationale For Transit Priority

The rationale for transit priority measures is based on the premise that buses can more efficiently carry commuters and deserve special privileges. R. W. Bowes, the Chief Transportation Planning Engineer for Deleuw Cather Canada stated "the competition for the limited roadspace in the CBD is very keen. There are many legitimate users, but priority must be assigned."[2]

The view that buses are efficient movers of commuters is not a new idea. In 1950 for example, Francis Turner of the U.S. Bureau of Public Roads stated that:

> The transit vehicle, while it is moving, is a much more efficient user of street space than a private car and the improvement of the transit system stands high in the work to be done for the relief of traffic congestion.[3]

The idea that buses deserve some sort of priority over the automobile was the basis of a study undertaken by the North Atlantic Treaty Organization. In the study, the committee noted that good transit service is seen by many as a right, and that congestion on our roadways is slowing the buses and making them less effective.[4]

---

[2] J. Alex Murray (ed.), Mass Transit: THE URBAN CRISIS OF NORTH AMERICA, Windsor: Canadian American Seminar, 1976, p. 228

[3] Francis Turner, "Moving People On Urban Highways" in URBAN TRANSPORTATION PERSPECTIVES AND PROBLEMS, eds. Herbert S. Levinson and Robert S. Weant, Westport: Eno Foundation For Transportation Inc., 1982, p.203

This view seems to raise a valid point that the rationale for priority should not be based solely on economics and that other considerations such as increasing the capacity of the roadway or, encouraging automobile users to use transit should be considered. The idea of transit priority represents a shift from traditional traffic engineering which looked at traffic flow in terms of vehicles rather than people. Ariel Alexander and Christian Avernous of the OECD environment committee noted this trend and stated that:

> The new management-oriented urban transportation policies are aimed at encouraging people in the city to make more efficient use of vehicles and infrastructure; emphasis is changed from moving vehicles to moving people."[5]

Views such as this are becoming more common. In the updated CANADIAN TRANSIT HANDBOOK, CUTA and RTAP noted that:

> because buses normally carry more people than other vehicles in relation to their use of road space, the efficiency of the transportation system as a whole can often be improved by giving buses priority over other vehicles for the use of limited roadspace."[6]

---

[4] NATO Committee on the Challenges of Modern Society, "Bus Priority Systems," in URBAN TRANSPORTATION PERSPECTIVES AND PROSPECTS, eds. Herbert S. Levinson and Robert A Weant. Wesport: Eno Foundation For Transportation, Inc., 1982, p. 289

[5] Ariel Alexander and Christian Avernous. Innovative Management of Urban Transport For a Better Environment" in TRANSPORTATION AND THE URBAN ENVIRONMENT, ed. National League of Cities, Washington: U. S. Department of Transportation, 1979, p. 29

[6] CUTA and RTAP, CANADIAN TRANSIT HANDBOOK (2nd ed), p. 12-1

Francis Turner in a paper on priority measures recalled an incident that took place while he was the U. S. Federal Highway Administrator. In this case an evaluation of a proposed transit lane was undertaken in his department. The evaluator determined the bus lane would be an inefficient use of roadspace as 67 percent of the peak hour vehicles were automobiles and less than 15 percent buses. However a later analysis revealed that based on people, the breakdown was 15 percent carried by automobile and 82 percent by bus.[7] This clearly illustrated the problems associated with looking at traffic problems in terms of vehicles rather than people.

## 3.3 Types of Transit Priority Measures

The CANADIAN TRANSIT HANDBOOK separated transit priority measures into four classes, "movement priority, bypass priority, exemption and special handling, and signal system priority."

Movement priority measures are designed to eliminate the conflict between automobiles and transit that is caused by congestion. The method most commonly used is to give transit exclusive use of a lane, or a portion of the lane. These transit lanes take primarily two forms. With-flow lanes, which run in the same direction as the normal traffic flow. These lanes could conceivably by located in any lane, although for the most part they are are located in the curb

[7] Francis Turner, "Moving People On Urban Highways", p. 206

lane, as this is most convenient for passenger loading and unloading.

The second form of exclusive transit lane is the contra-flow lane. These transit lanes run against the normal traffic flow. Commonly contra-flow lanes are located on one-way streets, and are usually provided in response to demand, or where one-way streets create routing problems. The second situation where contra-flow lanes are applicable is where the traffic flow along a roadway is unbalanced.

Other forms of movement priority are exclusive busways and bus only streets.

The second class of transit priority is by-pass priority. This form of priority is used in cases where the congestion is limited to specific points. This form of priority can take the form of exclusive lanes on approaches to intersections, tunnels or toll booths. The second form of by-pass priority are bus only gates.. These devices are designed to prohibit automobile passage while allowing transit access.

The third form of priority are exemptions and special handling. This refers to legislated privileges such as stopping, turning or merging where otherwise prohibited.

The fourth class is signal system priority. There are basically two types of signal system priority. The first is the bus activated signal. In this system the buses are linked electronically to the traffic signal system, and the signal is either activated automatically or manually. The signal is then either changed from red to green, or the green signal is extended so the bus can move through the intersection unimpeded. The second form is the preemption of the traffic signal. In this case the traffic signal pattern is altered to better suit transit speeds.

While all of these methods have been used with success in various urban areas the only priority methods that will be investigated will be contra-flow and with-flow exclusive transit lanes.

### 3.4 Rationale For Exclusive Transit Lanes

A 1976 study by the Organization for Economic Co-operation and Development (OECD) stated that the underlying reason for introducing bus lanes "is due to the implicit recognition of the different operating characteristics of each type of transport".[8] This is to say that buses, unlike private automobiles, run on a strict timetable, therefore if one route is slowed down, it not only affects those buses, but the entire system.

What then are the benefits of transit lanes? The most noticeable benefit is the relatively low cost of implementation. The costs are usually restricted to things such as, signs, traffic restricters, and public information. The costs of course vary with the locale. A 1977 study undertaken by M. M. Dillon revealed that the cost per kilometre of

[8] OECD Research Group. BUS LANES AND BUSWAY SYSTEMS, Paris: Organization For Economic Co-operation and Development, 1976, p. 11

with-flow transit lanes ranged from $2,337 per kilometre in St. Louis to $24,107 per kilometre in Arlington, while in Canada an examination of transit lane schemes in Toronto show their costs to be $9,803 per kilometre.[9]

The economic benefits extend far beyond the low start-up costs. The goal of transit lanes is to remove impediments from the lane so the speed of transit vehicles can increase. By doing so a number of benefits can be achieved. Pushkarev in his book URBAN RAIL IN AMERICA recognized the importance of increased vehicle speeds, he stated:

> Vehicle speed is of decisive importance in transit operations. Unlike increasing space and service frequency, which necessitate higher costs both to the passenger and to the operator. For the passenger, travel time is reduced; for the operator, fewer vehicles and fewer employees are needed as vehicles turn around faster.[10]

For example, if a trip takes 60 minutes, and there is a headway of 6 minutes, 10 buses will be needed to service the route. However, if vehicle speeds are increased, and the travel time is lowered to 30 minutes, only 5 buses would be needed to serve the route. Not only would the capital cost of 5 buses be saved, but more importantly the operating costs associated with these 5 buses would be eliminated. A 1982 study by the TTC determined that the elimination of a bus during the rush hour can save approximately $60,000 in operating costs per year as well as a capital cost saving of

[9] M. M. Dillon, NON CAPITAL INTENSIVE TRANSPORTATION OPTIONS, Winnipeg: Winnipeg Development Plan Review, 1978, p. 92-96.

[10] Boris S. Pushkarev, URBAN RAIL IN AMERICA, p. 57

$130,000. A bus reduction all day will result in a saving of $90,000 in annual operating costs plus the same saving of $130,000 in capital costs.[11]

The removal of impediments from the roadway not only results in increased vehicle speeds, but also regulates the bus speeds. J.J. Bakker in an address to the Canadian Urban Transit Association noted that:

> the greatest benefit that an exclusive transit lane has is that the speed of transit operation becomes predictable, which means that the reliability of the schedule can be assessed . . . the reliability of bus travel time will be greatly improved with the result that schedules become reliable, which, in turn will mean shorter waiting times at the bus stops".[12]

This is especially true in a climate like Winnipeg, as long waits at the bus stop in frigid weather can affect patronage. It must be noted that greater regularity of travel times has implications for the success of the recently initiated Telebus system as well.

The introduction of a transit lane also has the effect of increasing practical capacity of the roadway without the high cost of construction. For example, the practical capacity of a lane of an arterial street is 600 automobiles. At an average occupancy of 1.19 (Winnipeg average) this works out to 714 persons per hour. On the other hand, this

---

[11] IBI Group, RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, Toronto: Toronto Transit Commission, 1982 p. 20 With bus prices now running close to $200,000 the capital cost savings are even greater.

[12] J. J. Bakker, RUBLIC TRANSIT RIGHT-OF-WAY, Calgary: Prepared For the 1974 Annual Meeting of the Canadian Urban Transit Association, 1974 p. 2 and p. 5

same lane could carry 180 buses per hour each with a loading standard of 60 passengers which works out to 10,800 passengers per hour. While this level of bus service is higher than that attained on most streets, it does help to illustrate the effect of transit on roadway capacities.[13]

The advantage of transit lanes lies in the potential for increased vehicle speeds, which in turn affects, the efficiency of transit operations, the capacity of the roadway, and if the time savings is deemed by the public to be substantial, an increase in transit patronage.

There are, of course some disadvantages associated with transit lanes. One problem is related to enforcement. In order to be effective, the lanes must be free of other traffic. In some cases extra policing is needed to keep the lane clear. For example, in Ottawa during the introductory period for its transit lanes, one officer was needed per block to keep others out of the transit lane. This period is short however, and in Ottawa this high profile "resulted in excellent recognition and obedience of the new bus lane regulations by the driving public."[14] Due to this, patrols were allowed to return to normal levels with only a few violations occurring.

---

[13] The lane capacity of 600 automobiles or 180 buses per hour came from the IBI Group, RESERVED VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, P.23

[14] M. M. Dillon Ltd., EVALUATION OF EXCLUSIVE BUS LANE OPERATION CENTRAL OTTAWA, Ottawa: M. M. Dillon Ltd., 1974, p. 17

Another potential problem lies with vehicles turning on and off the roadway. As far as private access points are concerned, it seems to have limited effect on the operation of the transit lanes. In 1974 M. M. Dillon undertook a study evaluating the bus lanes in Ottawa. They found that "no significant problems have been experienced with major driveways and there seems no reason to fear that any will develop in future."[15] Regarding intersections, other than banning right turns, there are really few alternatives. In many cases the bus lanes are ended before the intersection, so right turning vehicles are allowed in the curb lane. In Paris, the authorities installed 2 traffic lights. One traffic light was for the transit lane, while the other was for the remaining lanes. The first light would go green, thus allowing transit vehicles priority though the intersection. The second light would then turn green, allowing the rest of the traffic through the intersection, as well as right turning vehicles.

The extra congestion in the other lanes after implementation has also been cited as a potential problem. If no automobile users switch to transit after implementation, the same number of automobiles have one fewer lane to travel in. In some cases this congestion will spread to parallel routes. As a result travel times for the automobile users must be monitored to determine if the time saving enjoyed by transit users compensates for the time loss suffered by

[15] ibid, p. 16

the automobiles. It must be noted that any extra congestion could have the positive impact of making transit look more attractive, and result in higher patronage for the transit system. Dietrich Sperling, a member of the German Bundestag stated that transit lanes;

> not only speeds the buses but motivates motorists caught in traffic jams, watching the buses speed by them, to reconsider their transit mode and often decide next time take the bus[16]

It is difficult to measure the effect on patronage of this psychological effect of seeing buses move through congested areas unimpeded, but the effect still seems real.

## 3.5 With Flow Transit Lanes

With flow exclusive transit lanes have ben defined by M. M. Dillon as:

> traffic lanes reserved for use by buses and other high occupancy vehicles where the vehicles continue to operate in the same direction as the normal traffic flow."[17]

As mentioned before, these lanes could conceivably be located in any lane, but due to passenger loading and unloading patterns the most popular choice appears to be the curb lane.

---

[16] Neal Pierce, "Urban Transport Today: A Global View "in TRANSPORTATION AND THE URBAN ENVIRONMENT, National League of Cities (ed), Washington: U. S. Department of Transportation, 1979, p. 6

[17] M. M. Dillon Ltd, NON-CAPITAL INTENSIVE TRANSPORTATION OPTION, p. 64

There are a number of criteria that must be met before a transit lane can be considered. For a curbside transit lane the Institute of Traffic Engineers identified 4 criteria that must be met before a lane is warranted:

- A curb transit lane is to be used only during those hours when curb access to abutting property is prohibited.
- The minimum transit lane volume should be 60 transit vehicles per peak hour per transit lane, or 400 vehicles per 12-hour period.
- The width of the roadway must be sufficient for at least two lanes of travel in addition to the transit lane in the same direction.
- During the peak hour, the number of transit passengers should be at least 50 percent greater that the number of people in all other vehicles on the street.[18]

It would seem however, that the above standards are viewed by most systems as being too restrictive, as a result most systems have formulated their own criteria. Regarding the first criterion most transit lanes are not exclusive as turning vehicles are allowed in the lane. As a result, although the terms exclusive or reserved are commonly used when referring to the lanes, this is not necessarily the case. R. M. Topp, Assistant Director of Planning for the Toronto Transit Commission (TTC) in an address to the Canadian Transit Association in 1973 stated that "the gen-

---

[18] John E. Baerwald, TRAFFIC ENGINEERING HANDBOOK, Washington: Institute of Traffic Engineers, 1965, p. 567

eral term reserved bus lane is not an absolute or exclusive right, but in practise, simply gets across to the public that the transit passenger is to be given a definite priority."[19] As a result, both Ottawa and Toronto have provisions in their traffic codes which permits "private vehicles to utilize the reserved lane within 150 feet of their point of access."[20] This provision, seems more realistic, as any limitations placed on residents or businesses along the route could easily lead to opposition to the plan. The I. T. E. minimum standard of 60 buses per hour for the transit lane is also very restrictive. Both Toronto and Ottawa use 20 buses per hour as a guideline, while Paris uses 15 buses per hour. The Province of Ontario, has used a minimum standard of 30 buses per hour for transit lanes schemes they plan to subsidize.[21] These seem much more realistic, as very few corridors see flows of 60 buses per hour.

the I.T.E. width standard appears to be fairly widely accepted, with most authorities seeing this as a minimum standard. This standard, however could be linked to lane utilization. If a curb-lane is not being utilized, there is no reason not to implement a transit lane.

---

[19] R. M. Topp, RESERVED BUS LANES Ottawa: An Address to The Annual Meeting of the Canadian Transit Association, 1973, p. 5

[20] S. Case and J. H. Kearns, RESERVED TRANSIT LANES, Toronto: Report of the Transportation Committee, the Municipality of Metropolitan Toronto, May 14, 1975, p. 6

[21] Province of Ontario, PROVINCIAL SUPPORT FOR IMPLEMENTATION OF RESERVED BUS LANES, Toronto: Government of Ontario, Management Committee, 1978, p. 12

The fourth standard, also seems to be acceptable, although it again depends on local conditions. The IBI Group in a document produced for the TTC stated that:

> Exclusive high occupancy vehicle lanes should be considered only if an overall increase in person carrying capacity of the corridor will result, or if a significant time saving for the existing user of that corridor would result."[22]

It seems an acceptable standard is, when transit carries as may people as each lane of automobiles, a transit lane is warranted. For example, the City of Baltimore has included in its traffic code a clause to this effect, which states:

> When the number of transit riders carried in one lane in a particular artery equals the number of occupants in automobiles in an adjoining traffic lane, the bus (or transit rider) is entitled to the exclusive use of the first lane".[23]

This view is shared by the U. S. federal government. Francis Turner, the former Federal Highway Administrator noted that:

> The Bureau of Public Roads takes the position that such reservation (bus lane) is reasonable if the usage by bus passengers exceeds the number of persons that would normally be moved in the same period in passenger cars.[24]

This warrant is consistent with the rationale of transit priority resting on the efficient movement of people rather than vehicles.

---

[22] IBI Group, RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, p. 23

[23] Ibid, p. 24

[24] Turner, "Moving People On Urban Highways," p. 203

The above warrants, are of course general, and warrants for specific schemes must take into account local conditions. The NATO Committee on the Challenges of Modern Society stated in its report "Bus Priority Systems" that:

> So far, few countries have specified official warrants for with-flow lanes; most leave the matter to be decided by the local authorities concerned. In any case, it would be undesireable to specify rigid warrants: they should be sufficiently flexible to permit adaptation to the local conditions.[25]

As a result these general guidelines must be put into the local context and take into account community goals and values. How these general principles of priority and minimum warrants have been applied in local situations will be explored in the next section.

## 3.6 Examples Of With-Flow Transit Lanes

Exclusive transit lanes have been implemented in many different locations with varying degrees of success. As stated earlier, the success or failure of a transit lane depends on many local factors. As such the results from other areas must be viewed in this light.

### 3.6.1 Ottawa

Ottawa, a city much the same size as Winnipeg, has a local government that is committed to providing good transit service. This commitment is illustrated by a clause in its official plan which states that council:

---

[25] NATO Committee on The Challenges of Modern Society, "Bus Priority Systems," p. 291

> will give precedence to public transit and/or commuter services over all forms of road construction or road widenings.[26]

In the downtown area transit lanes are located on Albert and Slater streets, a pair of east-west one-way streets. Both streets have fairly heavy transit traffic with levels of 31 to 52 buses using the streets in the A.M. peak hour, and 18-43 in the P.M. peak hour. The length of transit lane on these streets is relatively short, as they are only 1.3 kilometres long.[27]

On Albert Street, which runs in a westerly direction, both transit vehicles and automobiles enjoyed an increase in running speeds. The running speeds of transit vehicles increased 1.9 percent in the A. M. peak and 33.7 percent in the P.M. peak.[28] However, the overall travel times increased at the same time. This delay problem can be seen in a positive light however, as the delays were entirely due to increased loading times as a result of higher patronage.

The increase in the running speeds of the automobiles was probably due to a lack of interference by the buses, as they no longer had to stray out of the curb lane to pass slow moving or stopped vehicles. This increase of operating speeds had the effect of increasing the traffic volumes of

---

[26] Ottawa Carleton Regional Transit Commission, STRATEGIES PLAN AND FINANCIAL FORECAST, Ottawa: Ottawa Carleton Regional Transit Commission, 1984, p. 8

[27] M. M. Dillon Ltd., EVALUATION OF EXCLUSIVE BUS LANE OPERATION CENTRAL OTTAWA, Ottawa: M.M. Dillon Ltd., 1972, p. 15

[28] Ibid, p. 16

the roadway.

On Slater Street the transit vehicles enjoyed increased running speeds of 19 to 32 percent, while running speeds for other vehicles for the most part decreased. For transit vehicles an overall time saving of 16.2 percent in the A.M. peak and 14.4 percent in the P.M. peak were achieved.[29]

The third transit lane in Ottawa is located on Rideau Street, which is a major arterial street. The lane is located between Sussex Drive and Cobourg Street, a length of 1.6 kilometres. It is important to note that the eastern section (.8 kilometre) is a two-way four lane roadway, while the western section is two-way six lane roadway. In the peak hours between 41 and 96 buses travel along the route in an eastbound direction, and 37 to 112 in a westbound direction.[30]

On the eastern section of Rideau, transit vehicles experienced an increase in running speed of between 6 and 30 percent westbound, and between 3.2 and 6.1 percent eastbound. This worked out to an average increase of 1.6 kilometer per hour (KPH). The running speeds of the other vehicles increased for eastbound vehicles between 16.1 and 48.7 percent (5.2 and 11 KPH) while for westbound vehicles the average overall speed decreased from 1.8 to 15.5 percent.[31]

---

[29] Ibid, p. 21

[30] Ibid, p. 4

[31] Ibid, p. 8.1 and 8.2

On the western section both eastbound and westbound buses experienced increases in average overall speed. The increases ranged from a 2.8 KPH (34.2 percent) increase for westbound buses in the A.M. peak to a .35 KPH (2.9 percent) increase for eastbound traffic also in the A.M. peak.[32] As was the case in the eastern section, there was no significant change in the traffic volumes, with the changes ranging from an 11.6 percent increase in westbound traffic in the P.M. peak to a 5.4 percent decrease in westbound traffic in the A.M. peak.[33]

The transit lanes on all three streets have been judged favourablly. Overall 374 passenger hours per day have been saved. A 1974 consultants report by M. M. Dillon stated that "the bus lanes have been an outstanding success".[34]

### 3.6.2 Toronto

The Toronto Transit Commission (TTC) has introduced a number of transit lanes on a trial basis, and there have been both successes and failures. The first transit lane was established in 1971 on Eglinton Avenue. Eglinton Avenue was a 5 lane, 2-way roadway with the centre lane reserved for left hand turns in both directions. At the time of implementation there were 20 buses per hour using this route. The plan was to eliminate the centre turning lane,

---

[32] Ibid, p. 7.1 and 7.2

[33] Ibid, p. 7.3

[34] Ibid, p. 15

and to turn the eastbound curb lane into a transit lane. The lane was to run between Bathhurst and Yonge Streets in the A.M. peak and between Yonge Street and Brentcliffe road in the P.M. peak.

The result of the experiment was an increase of .8 KPH in the average travel speed, for a time saving of 35 seconds.[35] While this does not seem significant, the real benefit came from improvement in schedule adherence for the affected routes. It was during this trial period that a survey of the passengers was conducted. Of those surveyed, 85 percent felt the transit lane helped to improve the regularity of transit service. As well, many of those surveyed felt that the decrease in travel time was in excess of 8 minutes (actual 35 seconds). As a result 90 percent of the respondents felt that the transit lane should be retained on a permanent basis.[36]

The effect of the transit lane on other traffic was minimal, with the travel times of the other vehicles, as well as the traffic volumes only changing slightly. As a result the TTC recommended on February 9, 1973 that the transit lane be retained on a permanent basis, and a review be carried out to determine the suitability of other streets for such measures. On the basis of this recommendation the Metropolitan Council in April 1974 approved the implementation of transit

[35] J. H. Kearns, "Reserved Buslanes - Eglinton Avenue", (Toronto: Toronto Transit Commission, February 8, 1973) p. 6

[36] Ibid, p. 4

lanes on a number of streets on a trial basis.

Of the transit lanes implemented at that time, perhaps the most successful was the Pape Avenue transit lane. An evaluation by the Transportation Committee of Metropolitan Toronto reported that:

> The Pape Avenue reserved bus lanes are functioning extremely well from a transit standpoint, and as expected, there has been little deterioration in the general quality of service for private vehicle users. Prior to the introduction of the reserved lanes, the curb lanes were usually pre-empted by either the high frequency of bus travel or by parked vehicles. Consequently, little change in the private vehicle operation has been observed after formal designation of the curb lanes.[37]

As a result of this increased efficiency, savings of one bus on the Thornecliffe Park route, and one bus on the Leaside bus route were achieved. The financial savings associated with the elimination of these 2 buses was approximately $80,000 (1975 $) annually.[38]

The transit lane on York Mills Road has also achieved savings for the TTC. Bus travel times decreased by 14 percent, and this in turn lead to a 27 percent increase in ridership. If not for the transit lane, one more bus would have been required to accommodate this growth. The savings due to this rescheduling was approximately $80,000 in 1975.[39]

---

[37] S. Cass, and J. H. Kearns, "Reserved Transit Lanes", Toronto: Report of the Transportation Committee, Metropolitan Toronto, May 14, 1975), p. 5

[38] Ibid, p.5

[39] Ibid, p. 4

Unfortunately, these benefits were not shared by the other road users. For example, travel speeds for other users declined by 7 percent. This in turn lead to a 9 percent reduction in traffic volumes, which resulted in an 8 percent reduction in the number of persons travelling over the test zone.[40] While the TTC was in favour of retaining the lane, the Metropolitan Toronto Roads and Transportation Department opposed such a move, and the operation of the transit lane was discontinued.

The Wilson Avenue transit lane trial was also not viewed as a success. Although transit vehicles saved 40 seconds per trip, there was no corresponding increase in patronage. Journey times by automobile increased an average 64 seconds per trip. The net result was a 16 percent reduction in traffic volumes along the route.[41] The time savings experienced by transit vehicles was not viewed as significant enough to justify the continuance of the lane. This illustrates the importance of the warrants discussed earlier in the section, and that if a transit lane does not expand the practical capacity of the roadway it is not warranted from a traffic engineering standpoint.

---

[40] Ibid, p. 6

[41] S. Cass and J. H. Kearns, "Reserved Bus Lanes", Toronto: Report of the Transportation Committee, Metropolitan Toronto, November 12, 1975, p. 5

### 3.6.3 Paris

The City of Paris' use of exclusive transit lanes as a method of giving transit priority has grown considerably in the last 10 years. In 1973 there were only 13.5 kilometres of transit lanes in Paris, by 1985 there were over 100. In order for a route to be eligible for a transit lane, 2 criteria must be met. First, there has to be a bus flow of at least 15 buses per hour, and secondly, one-way streets must be at least 3 lanes wide, while two-way streets must be at least 8 lanes wide.[42]

The record of some of the lanes have been quite impressive, although problems do exist. In the first few years, passenger traffic was up 20 percent on routes using transit lanes compared to 11 percent for the rest of the system. As was the case with the Toronto and Ottawa examples, buses were better able to maintain scheduled times. The lost service kilometres due to missed runs, for example decreased 60 percent, while the late hours accumulated decreased by 37 percent.[43]

The problems associated with the lanes are quite similar to those experienced by North American transit lanes. Enforcement, for one is a problem, as in some cases only 15 buses per hour use the lanes and cars do stray into the lanes. Pedestrian safety has also been cited as a problem,

---

[42] Interview with Kent Smith, Department of Urban Affairs, Province of Manitoba, Winnipeg Manitoba, 2 August 1985

[43] IBI Groups RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, p. B-2

especially when contra-flow bus lanes were operated. Finally there is the problem with access to shops. To help alleviate this problem loading and unloading by delivery vehicles is allowed in the curb lane from 8:00 A.M. to 1:00 P.M. These problems have limited the success of the transit lanes, and the time savings have not been as significant as they might have been.

### 3.6.4 Dublin

In Dublin a one week experiment was carried out on a 2 kilometre stretch of a major arterial street leading to the CBD. The hours of operation of the bus lane was 8:00 to 9:30 A.M. During this period 12,500 persons commute over the route (3,700 by automobile). As well as the transit lanes, fares were lowered slightly, and 30 additional buses were added to the route (to bring the total up to 171).[44]

The results of this test confirm the results from other centres. The average bus speeds increased from 11 to 15 KPH. In terms of travel time this increase in speed resulted in the time being reduced from 10.6 to 8.4 minutes, a saving of 2.2 minutes or 20.8 percent.[45] As well, the regularity of service improved. Before the test 54 percent of transit vehicles operated within scheduled headways, during the test however, over 71 percent did so. The travel time

---

[44] OECD Group, TECHNIQUES OF IMPROVING URBAN CONDITIONS BY RESTRAINT OF ROAD TRAFFIC, Paris: OECD Group, 1973, p. 105

[45] Ibid, p. 106

for private traffic increased 26 percent. The result was a 13.1 percent increase in patronage, as well as a reduction in private vehicle traffic.[46]

### 3.6.5 Rome

In 1970 and 1971 numerous bus lanes were implemented on streets in Rome. In 1973 a study was carried out for the OECD of ten Rome bus routes that have at least 30 percent of their total route in bus lanes. The results of this survey illustrates how the increase in running speeds vary with local conditions. Of the ten bus routes the variations in speeds ranged from 8 percent (14.2 to 15.4 KPH) to 35 percent (11.2 to 15.2 KPH).[47] This shows the difficulty of trying to predict the change in speed.

A second benefit associated with the Rome bus lanes was an increase in weekly receipts which of course suggests an increase in patronage. On these routes the increase in receipts ranged from 1.2 to 16.1 percent.[48]

---

[46] IBI Group, RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, p. B-9

[47] F. Cecila, "How To Improve Urban traffic Conditions By Restraining Private Traffic" in TECHNIQUES OF IMPROVING URBAN CONDITIONS BY RESTRAINT OF ROAD TRAFFIC, OECD (ed), Paris: OECD, 1973, p. 36

[48] Ibid, p. 36

### 3.6.6 Arlington Virginia

In January 1974 a 5.6 Kilometre transit lane on Wilson Boulevard and a 7.2 Kilometre lane on Arlington Boulevard were opened. The results from both these lanes were consistent with each other. On both these routes 40 buses used the lanes in the peak periods. In both cases a 5 minute time saving was achieved per trip.[49]

The reason these examples are worth noting is that the savings were achieved in spite of right turning vehicles being allowed in the lane. As a result this example should be noted when considering the exclusive nature of a transit lane.

### 3.6.7 London

The results of transit lanes in London are worth mentioning, not because of great complexities, but because of the simplicity of the schemes. Most of the transit lanes in London are less than 914 metres in length. This is due to the results of a study that determined "50 percent of the total delays were caused on 10 percent of the intersection approaches."[50] In light of this it was felt that a few short transit lanes positioned on the approaches to congested intersections would free the buses from this congestion. It was estimated that:

---

[49] M. M. Dillon Ltd, NON-CAPITAL INTENSIVE TRANSPORTATION OPTIONS, p. 93

[50] P. W. Daniels, MOVEMENT IN CITIES, London: Methuen and Company Ltd., 1980, p. 277

> if 1 percent of the bus network in inner London were operated in bus lanes during the morning peak it would cure 10 percent of the total problem at that time of day; 2-3 percent coverage would cure over 30 percent of the problem.[51]

This situation is important to keep in mind as it illustrates the need to determine where the congestion occurs. In a situation such as this, the utility of a transit lane along the entire length of the route would have been minimal.

## 3.7 Contra-Flow Transit Lanes

Contra-flow transit lanes as defined by M. M. Dillon are:

> lanes reserved for use by buses and/or other high occupancy vehicles where these vehicles continue to travel in a direction opposite to that of the normal traffic flow.[52]

As stated earlier these lanes are used either on one-way streets to provide improved transit service, or on two-way streets with a traffic flow inbalance. For the purposes of this study, only the latter will be investigated as it is the only option that is applicable to the study area.

Contra-flow lanes are always located in the median lane. This allows buses fairly easy access when crossing over from the general traffic flow to the transit lane.

In the literature little difference is made between contra-flow and with- flow lanes, as a result it would be safe to assume that the warrants for contra-flow lanes would

---

[51] ibid, p. 277

[52] M. M. Dillon Ltd, NON CAPITAL INTENSIVE TRANSPORTATION OPTIONS, p. 69

be similar to the warrants used for with- flow lanes. However, due to the obvious differences, some modifications must be made.

The transit lane must of course be exclusive, due to obvious reasons of safety. This, of course differs from the with-flow lane. It is important to note that contra-flow lanes unlike with-flow lanes are self enforcing and it is difficult for any other traffic to wander into the lane.

There is no reason to change the minimum bus volume warrant, although if the traffic flow is unbalanced even a lower standard could be used as it would be displacing a relatively light traffic flow in that lane.

The minimum width warrant is similar, although it now applies to the opposite lanes. M. M. Dillon stated that "roadways where contra-flow lanes are to be implemented should be at least six lanes wide."[53] This allows for at least two lanes to operate in the opposite direction, or one lane if a buffer lane is to be used.

The relationship between bus riders versus automobile commuters is also difficult to determine. With contra-flow lanes the importance of the ratio of drivers in lanes adjacent to the bus lane running with the general traffic is not of upmost importance, as the contra-flow bus lane is not displacing any of these vehicles. The importance relationship in this case is the number of bus passengers versus the number of displaced drivers running in the opposite direc-

[53] Ibid, p. 69

tion. This again shows the importance of having a unbalanced traffic flow before contemplating a contra-flow lane.

As well as there being minor differances in minimum lane utilization warrants, there are also some advantages and disadvantages of contra- flow lanes as opposed to with-flow lanes.

The main advantage is fairly simple, as the capacity in the peak direction is increased. With-flow lanes also increase the capacity, but not to the same degree. In fact implementation of a contra-flow lane has the effect of increasing the real capacity of the roadway without any high construction costs. There are a few major disadvantages of contra-flow lanes as opposed to with-flow lanes. Firstly, there are operating costs associated with these lanes, that are not involved with with-flow lane operation. This is due to the need for some sort of lane dividers which must be used to separate the buses from the opposite traffic flow. The most common method of lane division involves the placing and removal of cones before and after the peak period. The costs of this can become quite high. In 1978 M. M. Dillon Ltd. estimated the cost to "vary from $7,500 km/yr to $500,000/km/yr.[54]

A second problem relates to the provision of intermediate stations and the problems associated with them. If stations are placed in the median (if applicable) there is a capital cost associated with providing these structures. There are

[54] Ibid, p. 71

also problems associated with having the riders cross the traffic to reach the bus stops. Perhaps the greatest problem would be caused by having different levels of service using the lane. In such cases local buses would be stopping at all stops. Express buses which by-pass these stops would either have to stop, (which is inefficient), pass (which is dangerous), or not use the lane (which makes the lane under utilized).

The next section will look at the results from contra-flow schemes implemented in Ottawa, Miami, San Francisco, and New York.

### 3.8 Examples Of Contra-Flow Transit Lanes

Contra-flow transit lanes, that run along two-way streets are not as common as with flow lanes. There are a few examples however that illustrate the costs and benefits of contra-flow lanes.

#### 3.8.1 Ottawa

The Ottawa River Parkway is a 9.6 Kilometre, four lane divided roadway which links the CBD to the west end of Ottawa. The Parkway was opened in 1967 although transit vehicles were not allowed on it until 1970. In 1974, the idea of implementing contra-flow transit lanes along 7.2 kilometres of the roadway was developed by the National Capital Commission, O.C. Transpo, and the Ottawa Carleton Traffic Engineering Department. The system was opened on March 4, 1974.[55]

The priority system is made up of two components. The first, is the reservation of the two lanes on the Parkway that run counter to the dominant traffic flow, for exclusive use by transit in the peak periods. The second component is a by-pass ramp at the Parkway Portage Bridge. The Contra-flow lanes are in operation on the outbound lanes in the morning (6:30-9:30 A.M.) and on the inbound lanes in the afternoon (3:30-6:30 P.M.). Before each period of operation 2 federal government 3 man crews close down the Parkway to general traffic, and, OC Transpo provides staff to operate the manned barriers. The implementation of the contra-flow lanes was justified by the fact 57 buses use the Parkway in the peak hours.[56]

The results of the lanes have been clouded as four events took place in March and April of 1974 which influenced the performance of the transit system. The events were:

- Ottawa River Parkway Contra-flow lanes opened
- The Federal Government initiated a variable work hour program which affected 35,000 of the 70,000 central area employees (this program had employees arrive and leave work at different times, thus lowering the peak traffic demand).
- OC Transpo expanded its service

---

[55] Deleuw Cather Ltd., OTTAWA RIVER PARKWAY CONTRA-FLOW BUS LANES, Ottawa: Transport Canada, 1979, p. 3

[56] Ibid, p. 17

- Federal Government employees had to start paying for parking privileges[57]

As a result, any change in mode selection, or congestion could not be directly linked to the implementation of the bus lane.

In 1975, however, a strike by Federal Government employees resulted in the abandonment of the contra-flow system for the duration of the strike. As a result, it was possible to compare transit performance with and without the priority measures.

In terms of travel time reduction, the lane and ramp accounted for a time saving of 4 minutes for A.M. eastbound transit vehicles (a reduction of 20 percent) and 5.6 minutes for P.M. westbound transit vehicles (a reduction of 30 percent).[58] This eliminated the need for four buses, with a total saving of 7.32 bus hours in the A.M. peak period.[59] However, due to the high operating costs of contra-flow lanes it was determined by a 1979 report of the lanes that "the annual savings to the Transit Commission are in the order of the annual costs of providing the system.[60] Even though the implementation of the contra-flow lanes has not been a financial success transit usage in the corridor has increased. As a result, from the perspective of transit

---

[57] Ibid, p. 19

[58] Ibid, p. 37

[59] Ibid, p. 40

[60] Ibid, p. 41

lanes as a means of increasing transit patronage, this scheme can be viewed as successful.

### 3.8.2 Miami

The Florida Department of Transportation undertook a demonstration project in 1974 that introduced both a contra-flow bus lane and a with-flow car pool lane to a 6.6 kilometre stretch of the South Dixie Highway leading to the Miami central business district. As a result of these measures, peak period bus ridership increased by more than 400 percent. As well, the users of these lanes saved on average 8 to 9 minutes, while automobile users in the other lanes experienced a 15 minute time loss.[61] Overall, the highway carried 2,400 , more persons during the hours of operation (7-9 A.M. and 4-6 P.M.) in 350 fewer vehicles.

After the 9 month trial period the contra-flow lanes were eliminated due to economic considerations. It was found that the operating costs of the contra-flow lane were $62,000 per month, most of which was for manually placing the lane dividers each morning and evening.[62]

---

[61] Alan Altshuler, THE URBAN TRANSPORTATION SYSTEM, Cambridge: The MIT Press, 1979 p. 352

[62] M. M. Dillon, NON CAPITAL INTENSIVE TRANSPORTATION OPTIONS, p. 106

### 3.8.3 San Francisco

The California Department of Transportation has implemented a number of transit priority measures in the Bay Area. One of these schemes is a 6.4 kilometre contra-flow transit lane on U.S. 101. This transit lane which operates only in the P.M. peak period is located on two of four southbound lanes. One of the lanes is reserved for transit vehicles, while the other acts as a buffer lane.

Although the lane is only in operation from 4-6:30 P.M., the lanes have to be closed from 2-8:00 P.M. to allow for the laying of cones to separate the contra-flow from the general traffic lanes. As of 1982, 100 buses used the lane daily.[63]

Although the buses saved up to 10 minutes over their previous travel times, the real benefit of the lane is associated with the greater dependability of travel times. Leonard Newman of the California Department of Transportation noted that:

> buses do not normally save time relative to autos but they enjoy a dependable ride since they are unaffected by congestion caused by an incident in the normal flow lanes.[64]

These improvements have resulted in a small increase in patronage for transit vehicles using this route.

---

[63] Leonard Newman, "Bus Carpool Freeway Lanes In San Francisc Area" in URBAN TRANSPORTATION PERSPECTIVES AND PROSPECTS, Herbert S. Levinson (ed), Westport: Eno Foundation For Transportation, 1982, p. 208

[64] Ibid, p. 209

The initial implementation cost of the project was $250,000 while the operating cost in 1978 was $5,000 per month.[65]

### 3.8.4 New York

In 1970 a contra-flow transit lane was implemented on the approach to the Lincoln Tunnel on Highway I-495. The Highway is a six lane divided highway that links Manhattan and New Jersey. From 7:30 to 9:30 A.M. the outbound median lane is converted into a contra-flow transit lane.[66]

The lane is separated from the general traffic flow by manually placed plastic cones and electronic changeable message signs. During the two hour peak periods "12,500 vehicles use four inbound tunnel lanes - 9300 cars, 1100 trucks, 1550 buses and 550 semitrailers . . . . . buses account for 12% of the vehicles using the tunnel, but carry 80% of the commuters.[67]

The benefits of the lane are felt by both transit and automobile users, as, the three general traffic lanes now move faster due to the removal of buses from these lanes. Buses have also been able to operate more efficiently and now save 15 minutes over their previous travel times. This

[65] M. M. Dillon, NON CAPITAL INTENSIVE TRANSPORTATION OPTIONS, p. 73

[66] U.S. Department of Transportation, URBAN CORRIDOR DEMONSTRATION PROJECT, Washington: Urban Mass Transportation Administration, 1974, p. 3

[67] Organization For Economic Cooperation and Development, TECHNIQUES OF IMPROVING URBAN CONDITIONS BY RESTRAINT OF ROAD TRAFFIC, p. 82

time saving is credited with helping to produce a 6 percent increase in patronage along this route .[68]

The costs of the lane are quite high, however as it cost $700,000 to implement this scheme, and $200,000 per year to operate it (1978 estimate).[69]

In light of these costs, the Metropolitan Transit Authority of New York, in response to a 1971 questionnaire noted that in terms of degree of success this lane could only be rated as a "stand-off".[70]

## 3.9 Conclusion

The success or failure of any transit lane scheme is very dependant on improvements in operating speeds and the corresponding reduction in travel times. While the minimum lane utilization warrants help the transportation planner determine if transit lanes are applicable, they do not guarantee a successful operation. This is especially true when one notes the high operating costs of contra-flow lanes, which can easily make a scheme uneconomical.

The examples contain a good cross section of both successes and failures, and again illustrate that no two corridors are the same, and before a lane is implemented the

---

[68] M. M. Dillon, NON CAPITAL INTENSIVE TRANSPORTATION OPTIONS, p. 73

[69] Ibid, p. 73

[70] William J. Ronan, "Reserved Bus Lanes," Response to a Questionnaire of the American Transit Association, September 15, 1971

existing traffic conditions must be investigated. The next chapter will look at both the existing transportation conditions in the corridor as well as how a transit lane can be implemented in light of these conditions.

## Chapter IV

## CASE STUDY: EXCLUSIVE TRANSIT LANE, PORTAGE AVENUE

> The ultimate benefit and criterion of a good transportation system is not saving of time but enrichment of choice, not how fast you get there but what you can find at the end of a trip of a given length. Transportation planning and city planning are not two different things but two sides of the same coin.[1]
>
> -- Hans Blumenfeld

### 4.1 Introduction

Before any detailed analysis of a transit priority scheme can be made, the environment in which these buses operate must be investigated. The three components that will be catalogued are, the general performance of Winnipeg Transit, as well as the traffic conditions and the level of transit service in the study area.

After the present transportation conditions have been investigated, the applicability of both with-flow and contra-flow transit lanes will be looked at.

---

[1] Blumenfeld, THE MODERN METROPOLIS, p.140

## 4.2 Introduction To Winnipeg Transit

The City of Winnipeg with a population in 1981 of 586,000 is one of the largest cities of Canada to have a bus-only transit system. In 1984 Winnipeg Transit operated "a fleet of 535 diesel buses and 13 Handi-Transit buses (for the physically disabled)".[2] The utilization of this transit system compares favourablly to other systems. As mentioned in Chapter One, rides per capita is a good indicator of system utilization. In 1981, the rides per capita on the Winnipeg Transit System was 103.75, this figure compares favorably with the national average of 98.81.[3]

Even with this high utilization of the system, Winnipeg Transit faces the same financial constraints as other transit systems. In 1983 the national average for transit revenue-cost ratios was .534. In Winnipeg, the recovery was lower and was only.440, although by 1985 this ratio was closer to .500.[4]

This resulted in a projected operating deficit of $32,127,313 for 1985.[5] As a result, the transit system has required government subsidization since the system first recorded a deficit in 1966. This deficit has been cost-

---

[2] R.J. Ferguson, MUNICIPAL MANUAL,CITY OF WINNIPEG,Winnipeg: City of Winnipeg, 1984, p.158

[3] City of Winnipeg, TRAVEL AND DEMOGRAPHIC TRENDS 1962-1981, p. 59, and CUTA, URBAN TRANSIT FACTS IN CANADA , p. 31

[4] CUTA, URBAN TRANSIT FACTS IN CANADA, p. 32 and Province of Manitoba Department of Urban Affairs files.

[5] Smith interview, March 6, 1986

shared equally by the municipal and provincial governments.[6]

## 4.3 Introduction To The Study Area

The actual study area is the Portage Avenue corridor, and is made up of super zones 22,23,24,25 and 36 as defined in THE CITY OF WINNIPEG TRAVEL AND DEMOGRAPHIC TRENDS 1962-1981 (see figure one)

The corridor had a population of 114,449 in 1981. This amounts to 20 percent of the total population of the city.[7]

Portage Avenue is a eight lane major arterial street. Under the street rating system used by the City of Winnipeg, Portage Avenue is listed as a regional street. This rating is based on the utility of the route and is not based on the carrying capacity or traffic flow. Portage Avenue is rated as a major external radial route, which means that it is a direct link to a Provincial Trunk Highway, in this case the Perimeter Highway. It must also be noted that not only is Portage Avenue a link to a major highway, but is also part of the Trans Canada Highway.

Parking is allowed along most of Portage Avenue, the exceptions being between Strathcona and Queen Streets due to a narrowing of the roadway to 3 lanes and the requirement of the curb lane for merging traffic between Empress and Queen

---

[6] The funding formula has evolved over the years so that now the grant is 50 percent of the City's audited transit system deficit, up to a ceiling fixed annually

[7] City of Winnipeg, TRAVEL AND DEMOGRAPHIC TRENDS, 1962-1981, p. 63

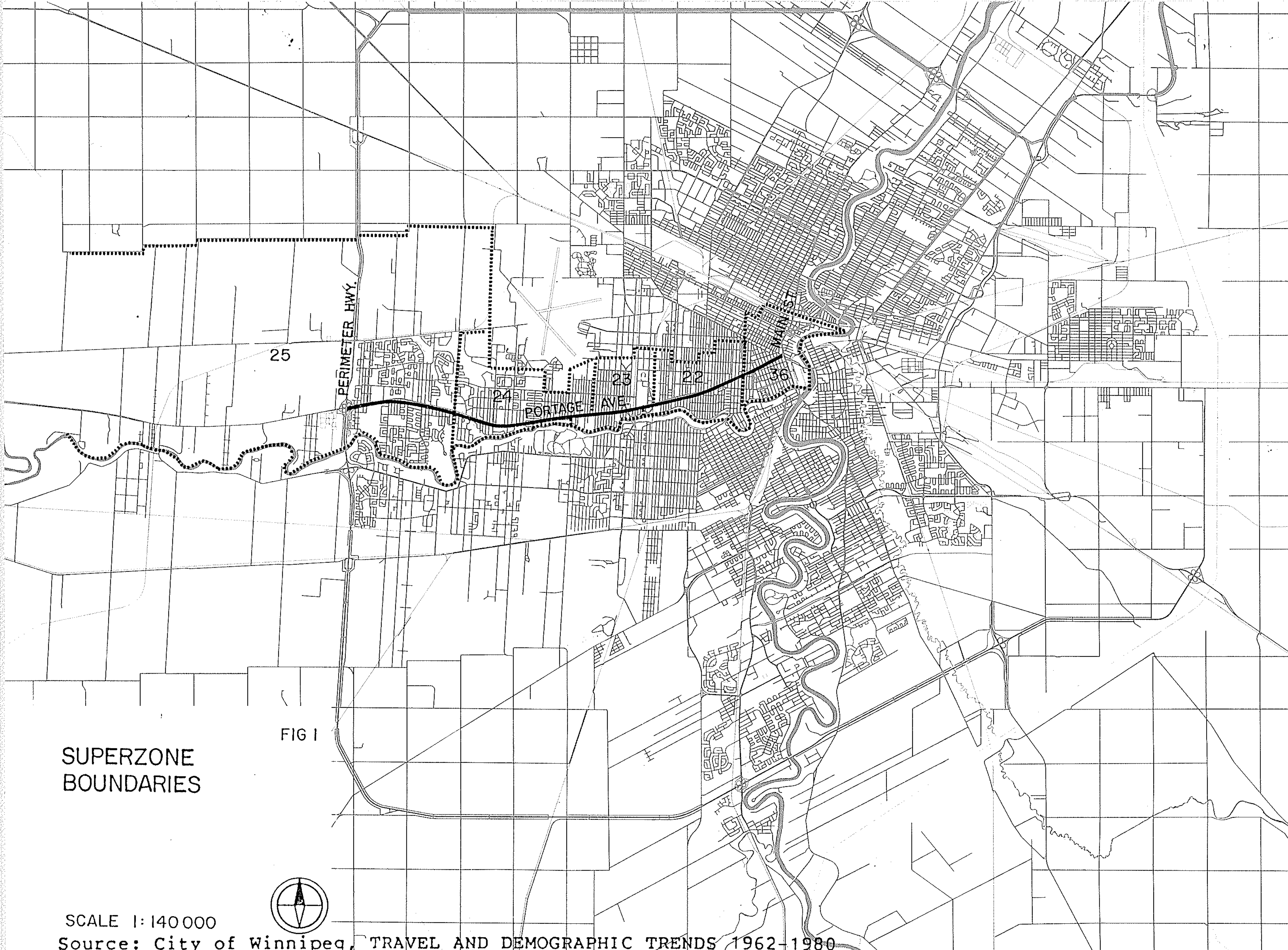



FIG I

SUPERZONE BOUNDARIES

Source: City of Winnipeg, TRAVEL AND DEMOGRAPHIC TRENDS 1962-1980

Streets. Parking is also prohibited at bus stops. The location of these bus stops is shown on figure two.

The third exception is the westbound curb lane in the P.M. peak, and eastbound curb lane in the A.M. peak. This parking ban presumably is undertaken to increase the roadway capacity in the peak direction during the rush hours.

Portage Avenue itself is the most used roadway in the city. From 7 A.M. to 7 P.M. 24,591 vehicles enter the CBD via Portage Avenue.[8] On the next busiest roadway (Osborne Street) only 13,754 vehicles enter the CBD.

The actual number of vehicles using a roadway is not relevant in itself. What is important however is the level of traffic congestion, and in turn how this congestion affects vehicle speed and travel times.

Figures three and four graphically show the growth and location of peak hour

congestion along Portage Avenue. In 1962, the congestion was confined primarily to the CBD. By 1981 however this traffic problem along Portage Avenue had more widespread and now this problem had spread to areas outside the CBD. This fact is backed up by a 1978 study of the City of Winnipeg Streets and Transportation Department which showed that volume was either approaching or exceeding capacity at every major intersection approach along Portage Avenue.[9]

[8] City of Winnipeg, TRAFFIC FLOW MAP, Winnipeg: Streets and Transportation Department, 1983

[9] City of Winnipeg, THE WINNIPEG REGIONAL TRANSPORTATION SYSTEM EXISTING CONDITIONS, Winnipeg: Winnipeg Develop-

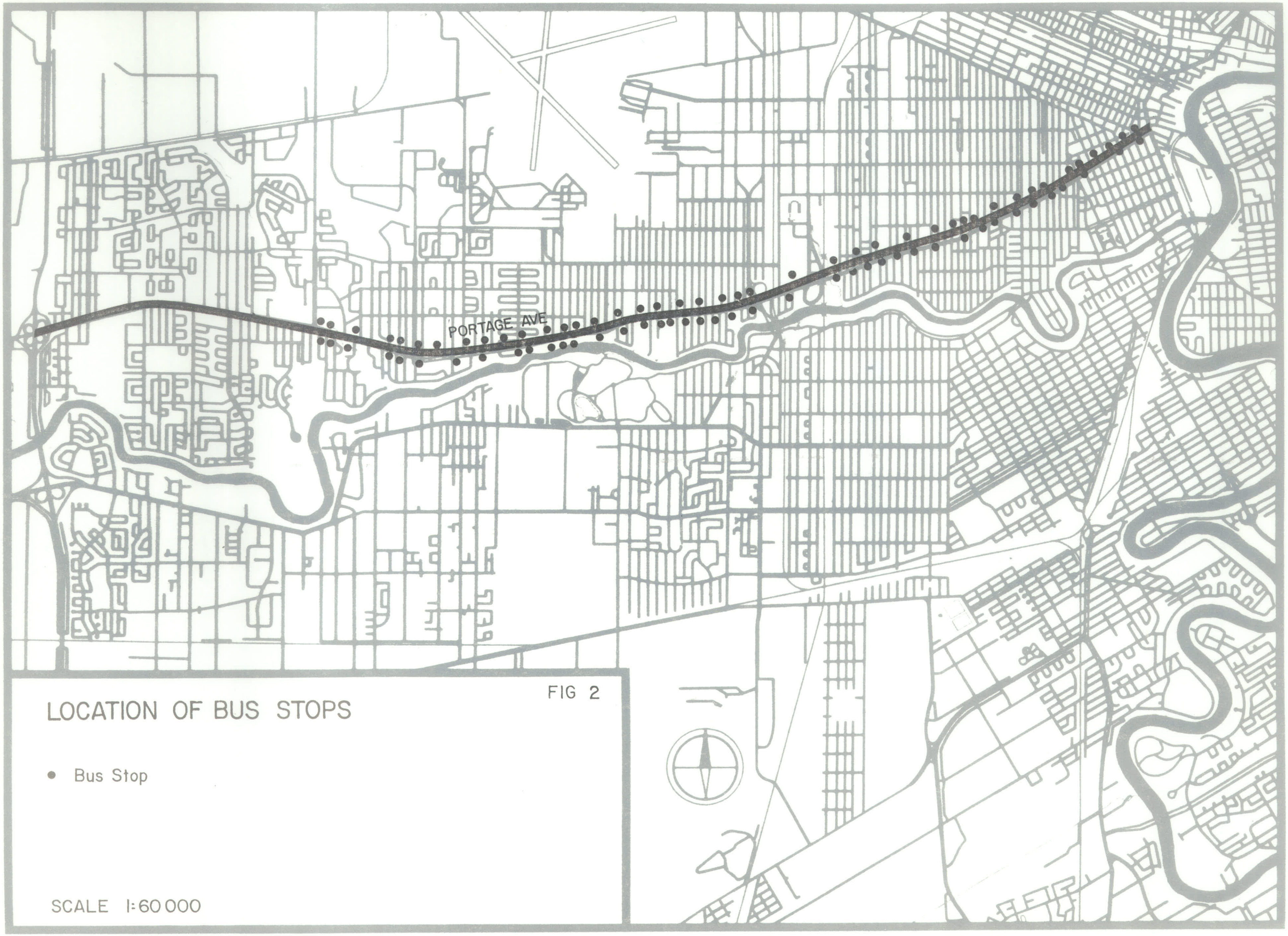
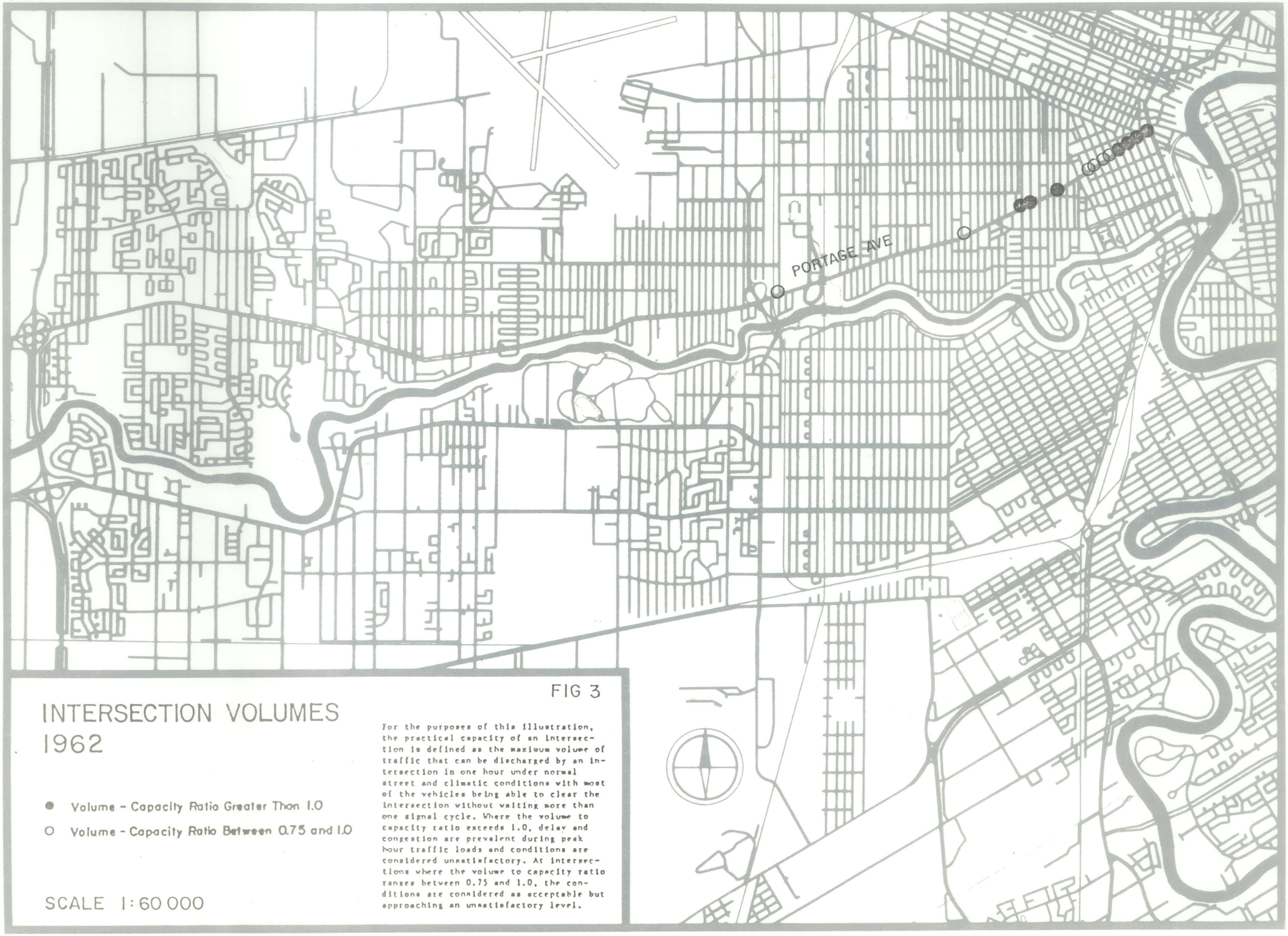
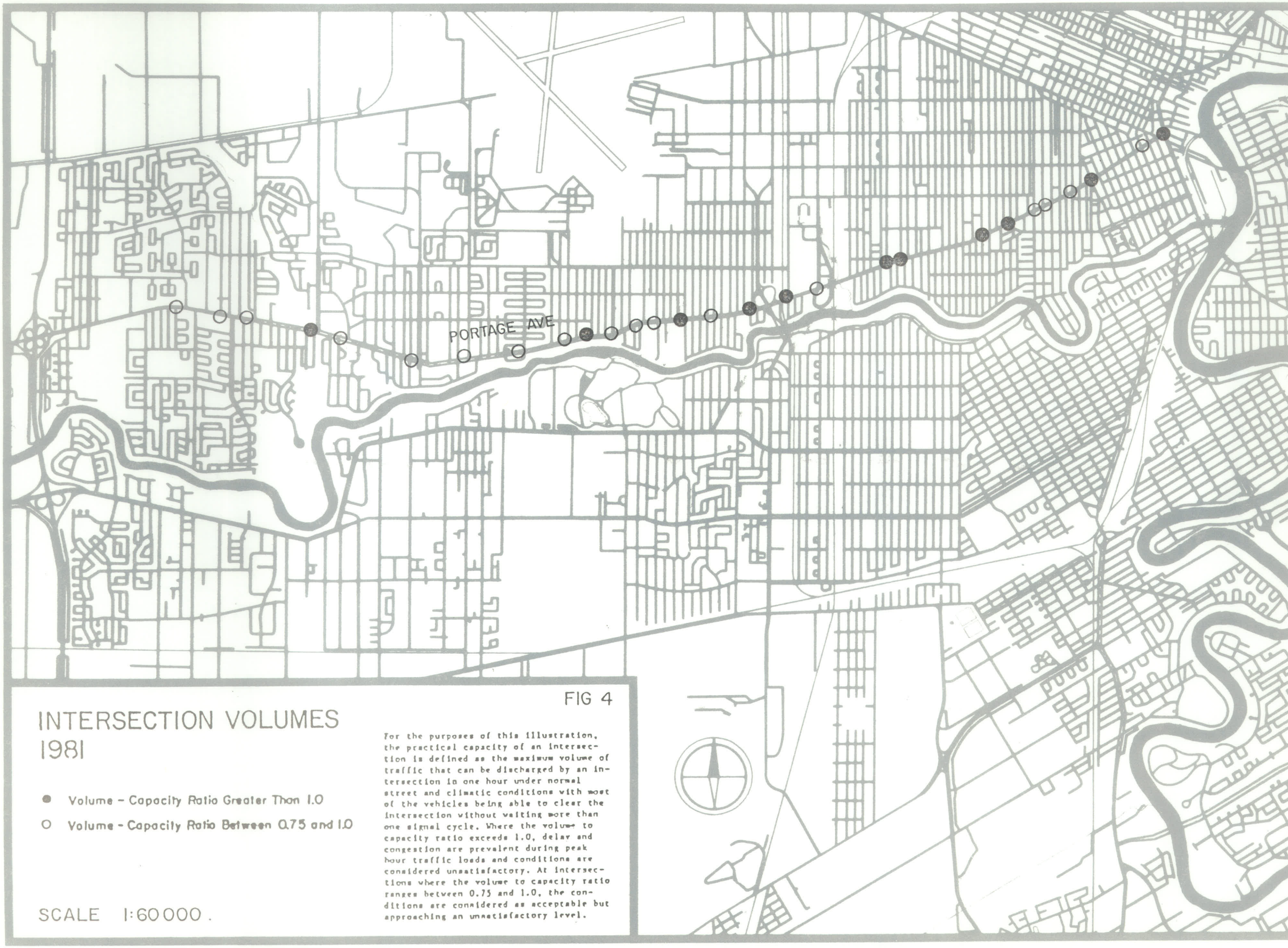



FIG 2

LOCATION OF BUS STOPS




Source: City of Winnipeg, TRAVEL AND DEMOGRAPHIC TRENDS 1962-1980




Source: City of Winnipeg, TRAVEL AND DEMOGRAPHIC TRENDS 1962-1980

Congestion obviously effects the operating speeds of vehicles along this route. Table 1 lists the operating speeds for automobiles and transit vehicles operating along Portage Avenue. This clearly illustrates the localized effect of congestion.

Table 1: Vehicle Operating Speeds: Portage Avenue (A.M. peak)

| STREET SECTION | SPEED (KPH) AUTOMOBILE | BUS |
|---|---|---|
| Sturgeon to Ferry | >40 | 16.1-32 |
| Ferry to St. James | 25-40 | 16.1-32 |
| St. James to Arlington | >40 | 16.1-32 |
| Arlington to Broadway | 25-40 | 16.1-32 |
| Broadway to Sherbrook | >40 | 16.1-32 |
| Sherbrook to Spence | 25-40 | 16.1-32 |
| Spence to Colony | <25 | 8.1-16 |
| Colony to Vaughn | 25-40 | 8.1-16 |
| Vaughn to Smith | >40 | 8.1-16 |
| Smith to Garry | 25-40 | 8.1-16 |
| Garry to Main | 25-40 | <8 |

The table clearly shows how automobile speeds vary from section to section. Buses on the other hand have progressively slower speeds as they near Portage and Main. This is due to the fact passenger loading times affect the average speed and since most of the loading and unloading is done in the CBD,the average speed is lowered. Also, a large number of signals are oriented to through traffic in the CBD which further reduces bus speed. As a result, the automobile

---

ment Plan Review, 1978, p. 25

operating speeds may be a better indicator of traffic congestion than transit speeds are, as automobile speeds are not affected by the distribution of passenger loadings. It takes approximately 15 minutes by automobile or 35 minutes by transit to travel from Sturgeon Road on the western boundary of the study area to Donald Street on the eastern edge of the area via Portage Avenue.[10]

There are at present three line haul routes that run along a substantial length of Portage Avenue. As well, 12 other routes service portions of the study area.[11]

The most frequent carrier is 11 Portage (see figure five).

This route links Polo Park Shopping Centre in the west to the CBD, and then continues to East Kildonan as 11 Kildonan. In the A.M. peak this service runs on a four minute headway, while in the non peak the headway is seven minutes.[12] In the peak periods between 19 and 21 buses serve this route with the buses being required to stop at all bus-stops.

The second busiest carrier is 21 Portage Red Express. This route links Grace Hospital in the west with the CBD (see figure six).

---

[10] Ibid, p. 22-23

[11] These routes are 12,18,24,26,29,61,66,71,78,79,83 and 97. It must be noted that this list does not take into account other routes which originate in the CBD. If these routes were taken into account the number would be much higher.

[12] City of Winnipeg Transit System, "11 Portage Bus Schedule", City of Winnipeg, 1985

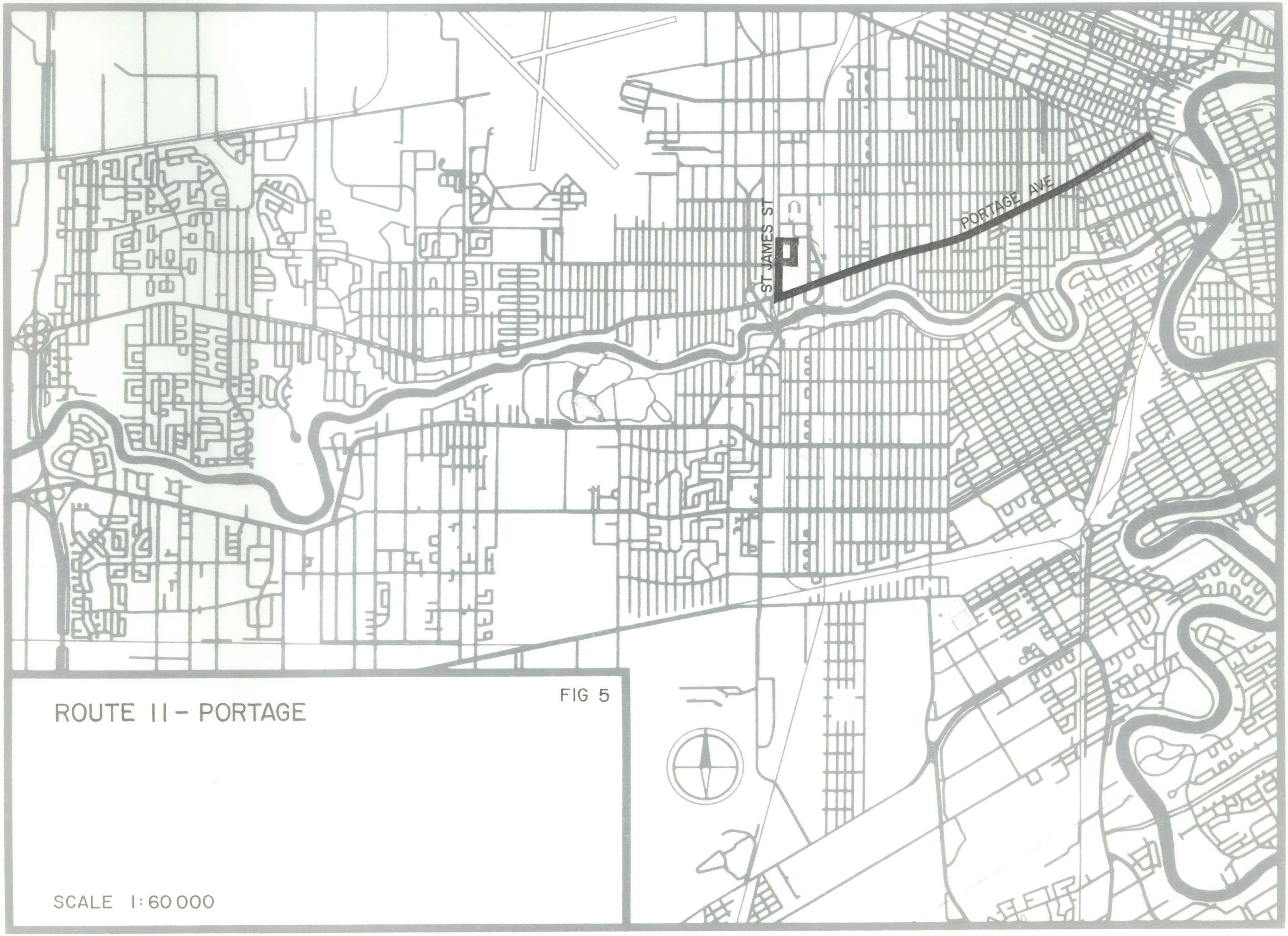



FIG 5

ROUTE 11 - PORTAGE

SCALE 1:60 000

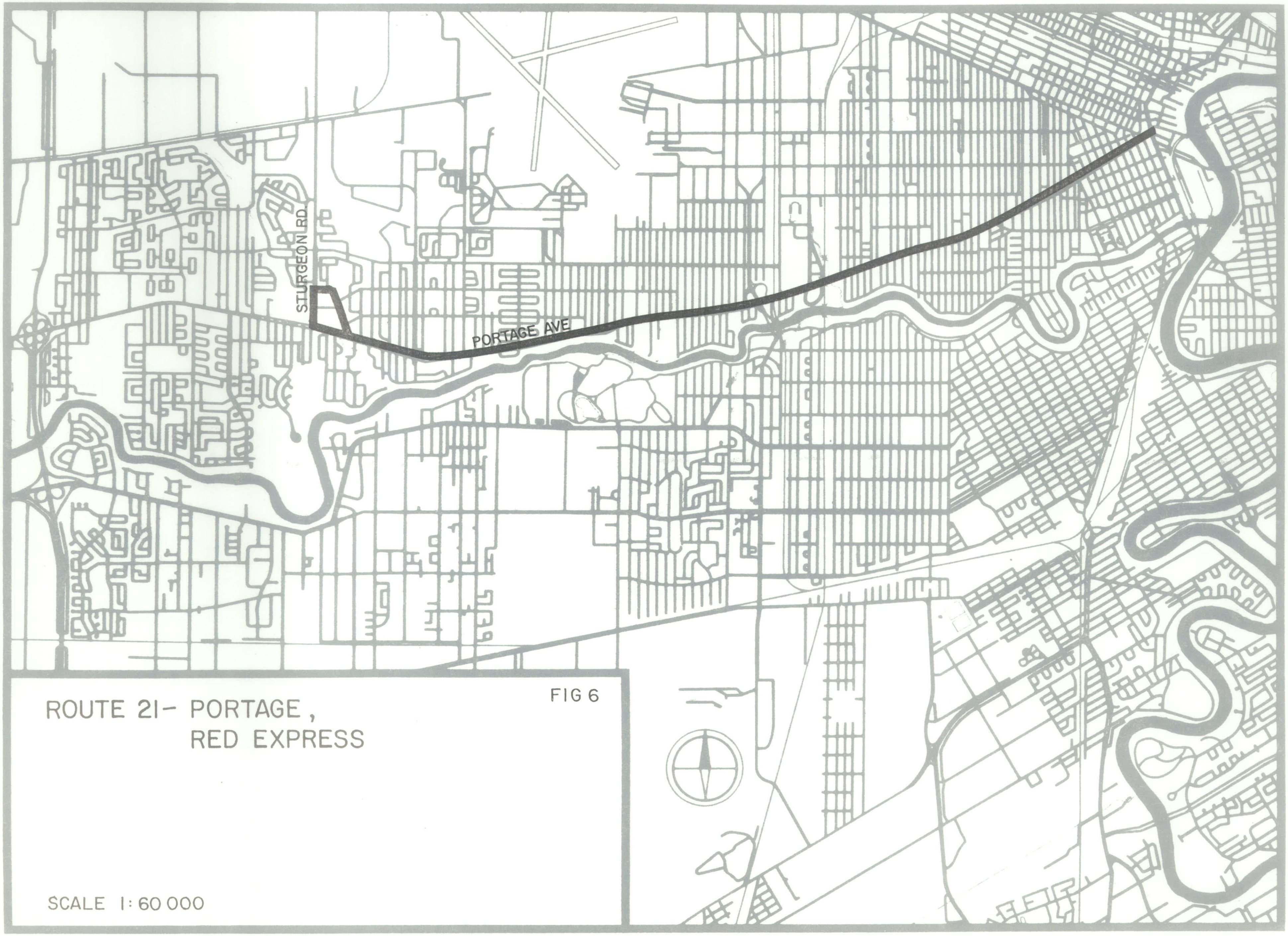



FIG 6

ROUTE 21- PORTAGE,
RED EXPRESS

SCALE 1: 60 000

In the A.M. peak this bus runs on a six minute headway, in non peak periods the headway is increased to nine minutes. In the A.M. peak, between 19 and 24 buses service the route.[13]

This route is a limited stop express route, so between Memorial Boulevard in the east and Polo Park in the west, buses only stop at selected bus-stops.

The final route is 22 Portage Green Express. This route alternately serves three suburban areas during the peak periods (see figure seven).
These buses run on a five minute headway in the peak and eight minute headway in the non-peak. During the peak periods 23 buses service this route.[14] This route also is a limited stop express route, with the buses making limited stops between Memorial and Sturgeon.

This results in a total of 39 buses per hour operating along Portage Avenue in the peak periods.

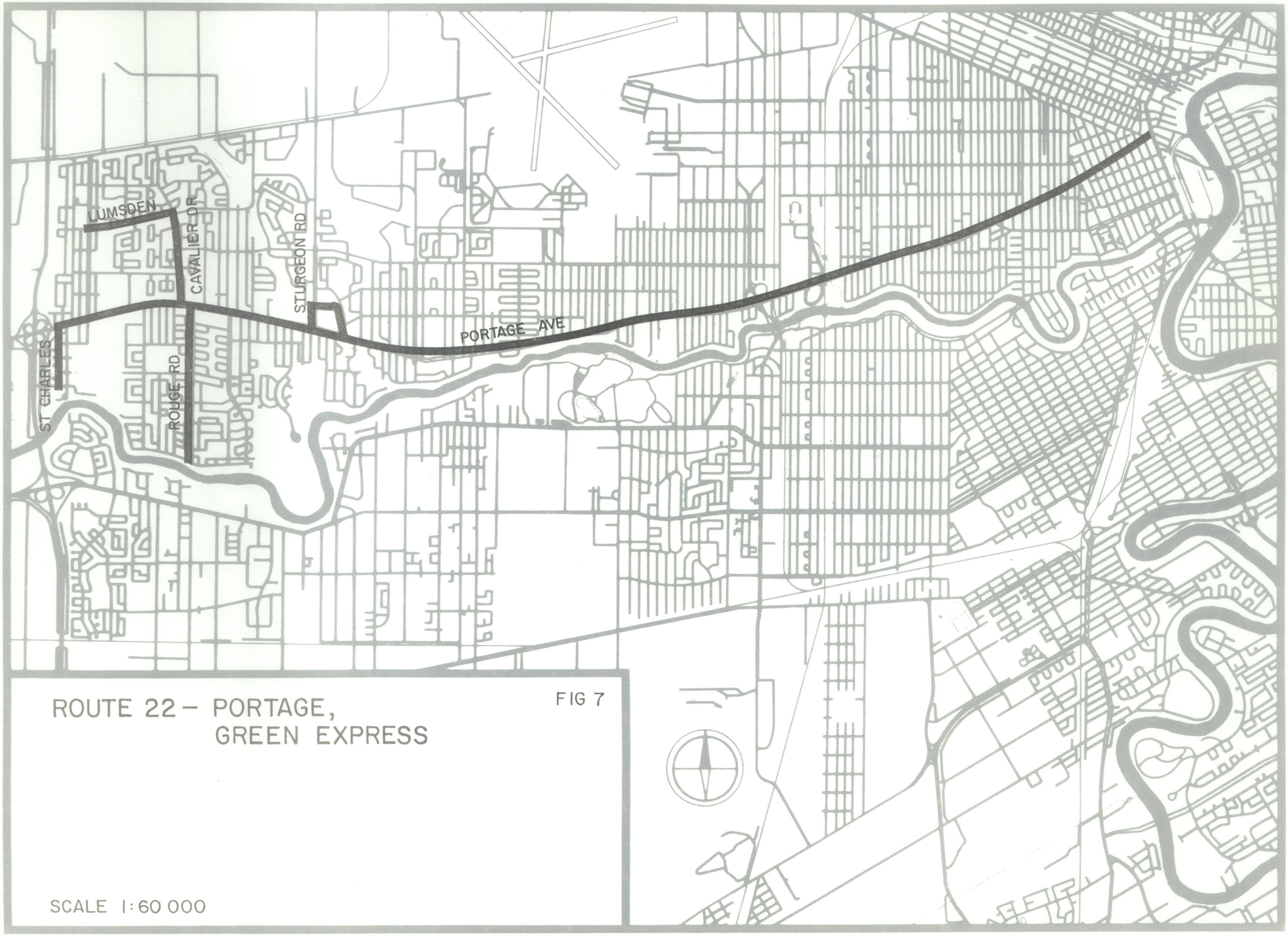
It must be noted that because buses share the roadway with other traffic, they are subject to delays due to congestion. These delays often cause the buses to deviate from the schedule. This deviation from the schedule is well illustrated in the Schedule Adherence index.[15]

---

[13] City of Winnipeg Transit System, "21 Portage Red Express Bus Schedule," City of Winnipeg, 1985

[14] City of Winnipeg Transit System, "22 Portage Green Express Bus Schedule," City of Winnipeg, 1985

[15] The Schedule Adherance Index is a record kept by Winnipeg Transit of all its local routes (adherence to schedule along the length of the route is not of upmost importance




ROUTE 22 - PORTAGE,
GREEN EXPRESS

FIG 7

SCALE 1:60 000

In September 1985 the deviation from the schedule for 11 Portage buses (inbound) was between 1.9 and 2.7 minutes.[16] While this deviation does not seem substantial it is when one realizes that for every bus running on schedule one must be running 4 to 5 minutes off schedule. In this period it was also determined that between 13 and 31 percent of the buses were either 2 minutes early or 3 minutes late.[17]

## 4.4 Options For Portage Avenue

As the demand for available roadspace increases, it becomes apparent that something must be done to expand the people moving capacity of the transportation system in the study area. There are basicly two ways a transportation system can be expanded. The first way is to simply expand the roadway itself. This of course allows more automobiles to use the system, which in turn encourages commuters to use their own automobiles. There are also the obvious financial and social costs associated with the widening of a major street such as Portage Avenue.

The preferred option is to promote the use of transit as a means to move commuters more efficiently. From both a Provincial and a Municipal viewpoint this is a more viable

---

for express buses as they pick up few passengers outside the CBD). This information is obtained by observation posts established along the route at various times during the year.

[16] City of Winnipeg Transit System, "Schedule Adherence Index," City of Winnipeg, September 1985

[17] Ibid

option. From a municipal perspective, this commitment is illustrated by a number of clauses in Plan Winnipeg, which adopted a transit oriented approach to its transportation planning. In sections 50(1) and 50(2) "Resolution of Capacity Deficiencies" it was noted in terms of policy that:

> The City shall undertake appropriate measures along major radial and circumferial corridors which hold the promise of resolving operational problems.

And further the objective stated were as follows:

> To maximize the function of the **existing** regional transportation system and to minimize the investment required for future additions to the existing system.[18]

This expansion of the existing transportation system is to take various forms, and transit priority is one method expected to be used to expand the capacity of the transportation system. This commitment to improved transit service is illustrated by the minutes from the June 25, 1985 report of the City of Winnipeg, Committee on Works and operations which stated that:

> The use of bus priority measures is consistent with the preferred transportation alternative in Plan Winnipeg. The Plan identifies the need for bus priority to increase the use of buses, especially during the rush hours.[19]

This strategy (as outlined in Plan Winnipeg) was to take the form of exclusive transit lanes along a few major roadways. In fact, transit priority as a means of improving the

---

[18] City of Winnipeg, BY-LAW NUMBER 2960/81, Winnipeg, 1983

[19] City of Winnipeg, "Report of the Committee on Works and Operations". June 25, 1985, p. 305.

operation of transit vehicles was part of the City's FIVE YEAR CAPITAL PROGRAM 1984-1988. This project was described as follows:

> Use of right curb lane as exclusive lane for transit vehicles along Portage Avenue from Sturgeon Road to Main Street and along Main Street to Market Avenue.[20]

While this project was not implemented (expected date of implementation was 1986) it does illustrate that projects of this type are at least considered by the city.

The Provincial commitment to promoting good transit service is arguablly as strong as the City's, although it is not a stated policy. This commitment however can be backed up two ways. Firstly, for Plan Winnipeg to be implemented, it must be approved by the Province of Manitoba. As a result the transit oriented approach to long term transportation planning suggests a provincial commitment to transit. Secondly, this commitment is illustrated by the use of its conditional grants to the City. In the fiscal year 1985/86, for example 85.7% of the provincial financial commitment to urban transportation was used to assist Winnipeg Transit (operating and capital).[21]

While it is apparent that the implementation of a transit lane scheme can be rationalized politically, it must be determined if such a scheme would be feasible in terms of

---

[20] City of Winnipeg, FIVE YEAR CAPITAL PROGRAM 1984-1988, Winnipeg: City of Winnipeg Board of Commissioners, 1983 p. 173

[21] Larry Desjardin, Letters to Mayor William Norrie, Febuary 22, 1985 and March 18, 1985

effect on the performance of transit and automobiles. The best tool with which to estimate the applicability of a scheme are the minimum lane utilization warrants.

## 4.5 With-Flow Transit Lane

In chapter two a number of warrants were examined. It is essential to compare the traffic conditions of the study area with these warrants to determine if a transit lane is feasable. The most basic warrant concerns bus traffic. These minimum levels vary from 15 buses per hour (Paris) to 20 buses (Toronto and Ottawa), all the way to 60 buses per hour (Institute of Traffic Engineers). The 15 buses per hour seems a bit low, officials in Paris have found that such low bus traffic has lead to automobiles straying into the lanes, which in turn resulted in lower travel speeds. On the other hand the standard set by the I.T.E seems too high. Acceptance of such a high standard would virtually eliminate most corridors in mid-sized Canadian cities from implementing transit lanes. The most realistic minimum standard seems to be 20 buses per hour. In both Toronto and Ottawa such levels have resulted in the implementation of successfully operated transit lanes.

In the peak periods, this minimum level is met throughout the study area. From Main Street to Tylehurst (Polo Park) all three routes are in service, this includes 16 buses serving 11 Portage, 13 buses serving 21 Portage Red Express and 10 buses serving 22 Portage Green Express. This adds up to 39 buses per hour in the peak periods. At Polo Park the 16 buses serving route 11 turn around and return to the CBD. As a result, from this point to Sturgeon Road (where the proposed lane would end) only 23 buses are in service. Even with this reduced level of service, the number of buses per hour (23) is still above the minimum standard of 20.

Before a transit lane can be considered, not only does there have to be a certain level of bus traffic, but there must also be a minimum level of patronage. For with-flow lanes, the minimum level depends on the amount of persons carried by automobiles in each of the other lanes. The acceptable minimum level of ridership is such that the number of bus passengers should equal the number of people carried by automobiles in the adjacent lanes. For example, a transit lane is justified on an 8 lane roadway such as Portage Avenue when transit carries one quarter of the people travelling over the route.[22] This can be measured by comparing ridership figures with the Traffic Flow Maps at various points in the study area. If the number of bus passengers is equal to or greater than the distribution of commuters per lane, the bus lane is justified.

Ridership figures obtained from Winnipeg Transit have been compared with traffic flow maps to determine the distribution of comuters. This comparison is made at two loca-

---

[22] IBI Group, RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, p. 23

tions. The first, Portage and Maryland takes into account ail three routes, while the second location, Portage of Tylehurst or St. James only takes into account the 22 and 23 routes. The following table will illustrate this relationship between automobile and transit commuters.

Table 2: Commuter Lane Distribution: Portage Avenue (with-flow lane)

Based on four lanes in each direction, and 1.19 persons per automobile

| | Transit Passengers | Auto Commuters | Total | Commuter /lanes | Transit /auto |
|---|---|---|---|---|---|
| *Portage at Maryland (in,A.M.) | 2557 | 2534 | 5090 | 1273 | 2.0 |
| *Portage at Maryland (out,A.M.) | 730 | 2304 | 3034 | 758 | .96 |
| *Portage at Maryland (in,P.M.) | 1662 | 2428 | 4090 | 1022 | 1.6 |
| *Portage at Maryland (out,P.M.) | 1977 | 3258 | 5235 | 1308 | 1.5 |
| *Portage at Tylehurst (in,A.M.) | 1172 | 2449 | 2621 | 905 | 1.3 |
| *Portage at St. James out,A.M.) | 251 | 1325 | 1575 | 394 | 0.6 |
| *Portage at Tylehurst (in,P.M.) | 555 | 1366 | 1921 | 480 | 1.2 |
| *Portage at St. James (out,P.M.) | 1246 | 3534 | 4780 | 1195 | 1.0 |

The table shows that in most cases the exclusive transit lane would be warranted in both directions, in both peak periods. The transit/lane distribution ratio illustrates this point. A ratio of less than one reveals that transit carries less than the adjacent lanes of automobiles. The only location this ratio is not met is in the A.M. outbound lane between Maryland and St. James Streets. However at Maryland Street the ratio is within .04 or 4 percent of being equal, as a result a transit lane could easily be justified at this location.

Between Polo Park and Sturgeon however an exclusive transit lane would only be carrying 63 percent of the commuters that are carried in adjacent lanes. While this may not be acceptable from a traffic engineering standpoint, it may still be justified from the perspective of promoting transit.

The third warrant deals with the exclusive nature of the transit lane. The I.T.E. for example views transit lanes as being totally exclusive. Some operators however (TTC, O.C. Transpo) recognize that in order not to disrupt the regular traffic flow too much, right turning vehicles must be allowed into the lane. This option seems to be the one favoured by the City of Winnipeg. In the FIVE YEAR CAPITAL PROGRAM 1984-1988 it was noted regarding this problem that, "right turns would be restricted at some strategic locations."[23]

---

[23] City of Winnipeg, FIVE YEAR CAPITAL PROGRAM 1984-1988, p.

In cases where the bus stop is located on the approach to an intersection with a high number of right turning automobiles, the best solution may be to simply move the bus stop from the near to the farside of the intersection. The buses would then be able to by-pass the right turning vehicles.

In Britain, research has been carried out by the Transport and Road Research Laboratory (TRRL) on how transit lanes should function at busy intersections. Their research determined that transit lanes should stop 60 metres short of junctions.[24] This length was chosen, as it allows for the full capacity of the intersection while ensuring buses are able to utilize the first green phase.

Determining the exact location of the transit lane was fairly easy to determine. For the west-bound lanes there is only one section of Portage Avenue where a transit lane would not be applicable, this being the section between Strathcona and Queen Streets (see figure eight).
This discontinuance of the transit lane is due to two reasons. Firstly, at the Canadian Pacific Railways underpass the roadway narrows to three lanes. While this is still wide enough to justify a lane, the traffic runs smoothly along this stretch and it is unlikely the implementation of a transit lane would actually improve the operating environment of transit. Secondly, even though the roadway again

175

[24] Peter R. White, PLANNING FOR PUBLIC TRANSPORT, London: Hutchinson and Company, 1976, p. 65

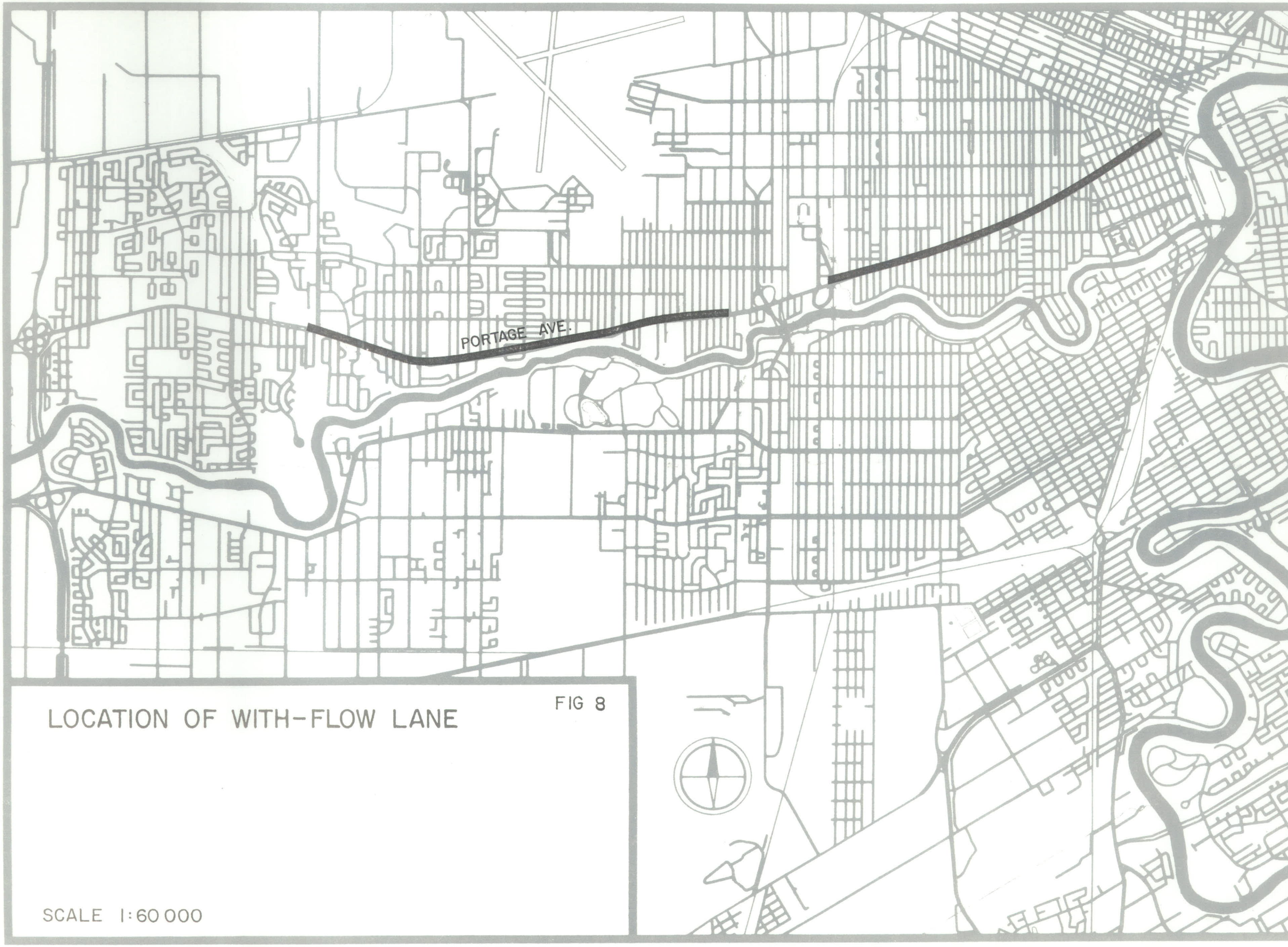



FIG 8

LOCATION OF WITH-FLOW LANE

SCALE 1:60 000

expands to at least four lanes west of the underpass the implementation of a transit lane would be unwise due to merging traffic. The Polo Park Shopping Centre is located between Empress and St. James Streets. As a result a large number of automobiles must use the outbound curb lane to enter and exit this retail shopping centre. As well, observations have shown that little congestion is experienced by transit vehicles at this location.

The same type of merging takes place between St. James and Queen Streets, at this point however traffic merges on and off route 90. It must be noted, on both these sections transit buses only use the curb lane to load and unload passengers. At the merging points the transit vehicles use the lane second from the curb to avoid merging automobiles. Due to this fact, a transit lane along this stretch would have limited utility.

For the eastbound lanes the same observations are applicable although Polo Park would have little influence on the lane. As a result, the lane would be discontinued only from Queen to St. James Streets due to the traffic merging on and off route 90, and again at the CPR underpass.

The real dilemma in determining the location of the lane is on the approaches to the many intersections along the route. After observing the traffic flow in the study area it became apparent that at no particular intersection approach could be singled out as having excessive congestion. In fact during one week of transit service observations only once was a transit vehicle not able to clear the intersection in one traffic light cycle.[25] As a result, the recommended policy is based on the findings of the TRRL,and the lanes will discontinue 60 metres short of intersections. The effects of this policy will have to monitored and if transit vehicles are impeded right turns could be restricted.

In order for this lane to be practical changes in the on street parking regulations along Portage will have to be made. As noted earlier, parking is restricted only in the peak periods in the peak directions. As a result, there are two options. In the first option the transit lanes would only function in the peak direction, while in the second option the transit lane would operate in both directions so parking would have to be banned in both curb lanes during both peak periods. The second option is clearly the preferred option. The observations have shown that congestion is experienced by transit vehicles in the non peak direction. Also, even when there is little congestion the transit vehicles operate below top speed to adhere to a schedule with congestion programed into it. As a result, the with flow transit lane should be in operation in both directions in both peak periods. Determining the peak periods is a arbitrary decision. In this case the peak periods are those

[25] These observations were made by riding the transit system during the peak periods in the week of February 10-14, 1985.

times when the hourly transit passenger count for Winnipeg transit is over 20,000 passengers. Using this measurement, the A.M. peak period would be from 7:00 to 8:30, while the P.M. peak would be 3:30 to 5:30. After a period of time, depending on the level of congestion the hours of operation could either be expanded or reduced to mirror the congestion.

A key advantage of the with-flow lane is its flexibility. Both local and express transit routes operate along Portage Avenue. This means that there are obvious operating differances, as the local buses stop more frequently. In a with-flow lane the express buses would be able to move out of the lane to by-pass buses stopped along the route. This is noteworthy along all sections of the study area as there are different levels of service.

The cost of such a project was estimated by the City of Winnipeg to be $70,000. These costs are to include "internally illuminated signs and other traffic restrictions."[26]

There are no operating costs to speak of, although some extra policing would be required to keep automobiles out of the lane in the first few weeks of operation.

---

[26] City of Winnipeg, FIVE YEAR CAPITAL PROGRAM 1984-1988, p. 175

## 4.6 Contra-Flow Transit Lane

For contra-flow lanes the warrants have to be modified somewhat. The minimum level of buses per hour is applicable to either scheme, and as stated earlier, from this viewpoint a lane is warranted.

The comparison of commuters in adjacent lanes for contra-flow lanes is very different from the form of comparison used for with-flow lanes. Since the lane deleted from the general traffic flow is running against the flow of the transit lane it is more logical to compare the number of transit commuters with the number of automobile and transit commuters distributed in the three lanes running in the opposite direction after implementation. Table 6 will show this relationship.

This table clearly illustrates that a contra-flow transit lane would be carrying more commuters than any of the three adjacent opposite flow lanes. In all cases this difference is significant with the proposed lane carrying as many as 2.5 time the commuters as the opposite flow lanes. As a result, from the viewpoint of commuters per lane, it is obvious that the lane is justified.

For obvious reasons of safety the contra-flow lane must be completely exclusive. Although there is no reason to restrict left turns at intersections with left turn lanes as the transit lane will use the turning lane, while left turning vehicles will use the adjacent lanes.

Table 3: Commuter Lane Distribution: Portage Avenue (contra-flow lane)

Based on 5 inbound lanes in the A.M., 5 outbound lanes in the P.M.,and 1.19 persons per automobile

| | Transit passengers peak direction | total Commuters off-peak | Off-peak Commuters per lane | Transit /other |
|---|---|---|---|---|
| Portage at Maryland A.M.,lane in | 2557 | 3034 | 1011 | 2.5 |
| Portage at Tylehurst A.M.,lane in | 1172 | 1575 | 525 | 2.2 |
| Portage at Maryland P.M.,lane out | 1977 | 4090 | 1363 | 1.5 |
| Portage at Tylehurst P.M.,lane out | 1246 | 1921 | 640 | 1.9 |

Realistically the contra-flow lane can only operate in the peak direction (inbound in the A.M. peak and outbound in the P.M. peak). While the lane would be in operation only from 7:00 to 8:30 in the morning and 3:30 to 5:30 in the afternoon, the lanes would have to be closed for a period longer than this to set up the lane dividers. This set up period would range from one to two hours. This means the lane would be closed to general traffic at minimum from 6:00 to 9:30 in the morning and 2:30 to 6:30 in the afternoon.

The initial start-up costs of the lane would probably be similar to the costs for the with-flow lane. The real differance lies with the operating costs. The examples in the previous chapter showed the monthly operating costs ranging from $4167 (1975$) in Ottawa, and $5,000 (1978$) in San Francisco, to $16,000 (1978$) in New York and $62,000 (1975$) in Miami.

While it is hoped that the operating costs will not reach these extremes, the potentially high operating costs must be noted.

## 4.7 Conclusion

This chapter presented the existing transportation conditions of Portage Avenue and compared these conditions to the minimum lane utilization warrants developed in Chapter Three. From this comparison it became apparent that congestion does occur along Portage Avenue, and it is spread throughout the length of the route. Add to this the fact that the transit system is utilized to a high enough degree suggests that the implementation of either a contra-flow or with-flow transit lane is warranted.

This analysis however must go one step further and answer two basic questions. The first question, regards how much time can realistically be trimmed from the travel times of transit vehicles? As stated earlier, the increase in speed, and the corresponding reduction in travel time is the most important factor to consider when investigating the applicability of a transit lane. The second question that must be answered is, which alternative is more applicable to Portage Avenue? Both of these questions will be answered in chapter four.

## Chapter V

## EVALUATION OF OPTIONS

> The car is an article of dress without which we feel uncertain, unclad and incomplete in the urban compound.[1]
>
> -Marshall McLuhan

### 5.1 Introduction

A pure description of the two options is not complete in itself, and it is important to estimate the effects the transit lane will have on existing traffic patterns. This chapter will take the analysis one step further by comparing the costs and benefits of the with-flow and contra-flow transit lanes with each other, and to a lesser degree with the present situation.

Ideally, the implementation of a transit lane could be justified merely on the principle that transit vehicles deserve some form of priority over automobiles. This is not the case however as experience has shown that success or failure is usually measured in travel time savings for transit vehicles or delays for automobiles. As a result, some form of model had to be developed which would determine the effect of the transit lane on travel times. The transit

[1] Marshall McLuhan, UNDERSTANDING MEDIA, THE EXTENSIONS OF MAN, New York: McGraw-Hill, 1964, p.217

lane simulation model was developed to anticipate the effects of the lane. The model, as well as the results of the test will have to be analyzed. These results will then be used to compare the options.

In this section the two options will be compared, and it will be determined which is the optimal solution to the Portage Avenue traffic problem.

## 5.2 The Transit Lane Simulation Model

In any study of this type it is difficult to predict accurately the effect of a transit lane on the travel times of transit vehicles. Originally the idea was simply, to measure the amount of delay time associated with traffic congestion. Unfortunatly this simple method fails to address one major problem, concerning the nature of congestion itself. Traffic patterns change from hour to hour and day to day. As a result the anticipated time loss associated with congestion must be programmed into the schedule. In order to maintain this schedule, buses behind schedule will attempt to speed up, while buses ahead of schedule will either reduce speed or stop completely to adhere to the schedule.

A 1973 study by the South-East Lancashire and North-East Chesire Passenger Transport Executive (SELNEC) determined that even in the off peak hours considerable waste is built into bus schedules. It is an adaptation of this study which will be used to simulate the conditions experienced by buses running along the proposed transit lane. In the British study timings were taken on three buses running along a 9.5 mile route on a Sunday morning. Simulated passenger loading times were added to the running times. It took the 3 buses, 36, 33, and 35 minutes to run a route that usually takes 46 minutes in the off-peak hours and 58 minutes during the peak. As a result it as noted that even the off-peak schedule has 10 minutes of waste programed into it.[2] As the British model takes into account passenger loading times and the effect these delays have on running times, it was felt that an adaptation of this model could be applicable to the Portage Avenue situation.

### 5.2.1 Components of the Model

There are four components to the Transit Lane Simulation Model,

- Fieldwork-the operation of the buses were observed for a period of one week (2 round trips per day) paying special attention to:
  1. location of congestion
  2. amount of stop time at the bus stops
  3. location of the stop time
- Analyzing- averaged the observed stop time information for both the A.M. and P.M. transit runs and noted the range in travel times

---

[2] Bendixson, INSTEAD OF CARS, p. 101

- Simulated bus operations- using a car, and taking particular care to mimic the acceleration and decelerateion rates of a bus, two round trips were made stopping at the appropriate bus stops.The first trip simulating the A.M. transit lane and the second trip simulating the P.M. transit lane.
- Calculation- based on the results of the two runs the travel time savings associated with the implementation of the transit lane were calculated.

### 5.2.2 Methodology of the Model

The first step in the application of this model to the Portage Avenue corridor was to go into the field and observe the amount and location of passengers loading times. The location of the stops is necessary to properly simulate the effect of the traffic lights on travel times. If one merely noted the amount of passenger stop time and added it to the straight running time, the effect traffic light cycles have on total travel time would not be taken into account. On Portage Avenue, for example, the traffic lights are timed so a vehicle operating at 60 KPH should hit only green phases.[3] By having the test vehicle stop for the assigned times between traffic lights, a more realistic simulation of bus operations was achieved.

---

[3] Peter Hague Interview

The data was collected through observations carried out in the field. 22 Portage Red Express was selected as it runs along the entire length of the study route This route was chosen as it ran the entire length of the study area and offered two levels of service.

To properly simulate the operating environment of transit vehicles on Portage Avenue it was necessary to determine not only how long buses stopped at bus stops, but also note which bus stops were stopped at. These observations could only be made by actually riding the buses, which was done for a period of one work week (Monday-Friday). Each day two round trips were made, one in the A.M. peak and one in the P.M. peak for a total of five round trips in both the A.M. and P.M. peak periods. The trips were staggered slightly within each peak period to take into account hourly variations in traffic conditions.

The second aspect of this model was the simulation of the transit lane. This involved operating an automobile along Portage Avenue on a Sunday morning, imitating a bus. This imitation process took two forms. Firstly, the acceleration and decelerateion rates of the buses had to be simulated. The rate of decelerateion for a transit vehicle is 7 kilometres per hour per second, while the acceleration rate is 3 kilometres per second.[4]

---

[4] Hague Interview, January 3, 1986

Replicating the acceleration rate of a bus was difficult in an automobile which has an acceleration rate considerably higher than a bus. It is necessary to use these rates however if the results are to be accurate.

The second task involved averaging the observed bus stop dwell times between each traffic light, and stopping the vehicles for the assigned time. Table four shows the average stop times for buses running along Portage Avenue.

The testing was carried out on Sunday February 15, 1986 and involved two round trip test runs, one simulating the A.M. peak and the other, the P.M. peak.

The actual running time (total travel time - simulated passenger loading times) was consistent in each of the tests. The results of the test will be further explored in the comparison of the with-flow transit lane and the contra-flow transit lane.

Table 4: Average Bus Stop Loading Times On Portage Avenue

| Street Section | A.M. peak (sec) in | A.M. peak (sec) out | P.M. peak (sec) in | P.M. peak (sec) out |
|---|---|---|---|---|
| Fort-Garry | 20 | 15 | 20 | 30 |
| Garry-Smith | 0 | 0 | 0 | 0 |
| Smith-Donald | 0 | 33 | 0 | 56 |
| Donald-Hargrave | 20 | 0 | 25 | 0 |
| Hargrave-Carleton | 0 | 18 | 0 | 18 |
| Carleton-Edmonton | 0 | 0 | 0 | 0 |
| Edmonton-Kennedy | 11 | 0 | 8 | 15 |
| Kennedy-Vaughn | 0 | 0 | 0 | 0 |
| Vaughn-Colony | 28 | 24 | 16 | 23 |
| Colony-Spence | 0 | 0 | 0 | 0 |
| Spence-Sherbrooke | 13 | 15 | 13 | 25 |
| Sherbrooke-Maryland | 0 | 0 | 0 | 0 |
| Maryland-Toronto | 10 | 15 | 6 | 15 |
| Toronto-Arlington | 0 | 0 | 0 | 0 |
| Arlington-Sherbourne | 14 | 19 | 13 | 30 |
| Sherbourne-Dominion | 0 | 0 | 0 | 0 |
| Dominion-Erin | 0 | 0 | 0 | 0 |
| Erin-Valour | 0 | 3 | 0 | 13 |
| Valour-Tylehurst | 8 | 28 | 9 | 40 |
| Tylehurst-St.James | 33 | 0 | 63 | 0 |
| St.James-Queen | 16 | 30 | 3 | 9 |
| Queen-Berry | 4 | 4 | 0 | 3 |
| Berry-Ferry | 35 | 29 | 0 | 3 |
| Ferry-Rutland | 30 | 20 | 13 | 5 |
| Rutland-Linwood | 24 | 33 | 17 | 24 |
| Linwood-Olesdale | 0 | 5 | 0 | 9 |
| Olesdale-Woodlawn | 19 | 11 | 5 | 11 |
| Woodlawn-Sharpe | 9 | 28 | 5 | 16 |
| Sharpe-Mount Royal | 24 | 20 | 18 | 11 |
| Mount Royal-Whytewold | 48 | 10 | 19 | 25 |
| Whytewold-Moray | 60 | 28 | 21 | 18 |
| Moray-Ronald | 13 | 11 | 0 | 14 |
| Ronald-Woodhaven | 0 | 15 | 0 | 11 |
| Woodhaven-Sturgeon | 54 | 0 | 35 | 0 |
| **TOTAL (minutes)** | **7.8** | **6.9** | **5.2** | **7.1** |

## 5.3 Comparison of Options

For the purposes of this study, eight criteria will be used to compare the two options, travel time savings, schedule regularity, adaptability, costs (both capital and operating), effect on other road users, accessibility and location of bus stops, and probability of implementation.

Travel time savings will be fairly easy to obtain through the results of the transit lane simulation model. It must be noted that not only will actual travel times be predicted, but also regularity of service.

Adaptability, is the ability of the scheme to accommodate different levels of service. The monetary costs of the two alternatives will be fairly easy to compare, as the cost of implementation will be comparable and the bulk of the comparison will focus on the difference in operating costs. The effect on other road users will be a fairly subjective analysis as it is difficult to accurately measure any inconvenience experienced by automobile users. Accessibility of bus-stops refers to changes in passenger safety, or loss of convenience associated with any change in the location of bus stops. If a contra-flow scheme is adopted, some bus-stops will have to be located in the median and there will be problems associated with such a move. Also, if the transit lane is located in the curb-lane the whole issue of nearside versus farside bus-stops will have to be addressed. The final area of analysis is the probability of implementation. This refers to the views of Winnipeg Transit as to their preference, and thoughts on the scheme. Each of these areas will now be addressed.

### 5.3.1 Travel Time Savings

It is assumed that travel time savings will be comparable for each option. As a result, the difference lies in the fact a with-flow lane can be utilized in both directions. The transit lane Simulation Model produced the following travel times from Sturgeon Road to Main Street:

- Inbound lanes, A.M. peak- 26 minutes
- Outbound lane, A.M. peak-25 minutes
- Inbound lane, P.M. peak-25.6 minutes
- Outbound lane, P.M. Peak-26.5 minutes

According to the TRAVEL AND DEMOGRAPHIC TRENDS 1962-1981 the estimated travel time for this trip by transit is 35 minutes.[5]

Based on these figures the expected travel time savings after the implementation of the transit lanes would be:

- Inbound Lane, A.M. peak-9 minutes
- Outbound Lane, A.M. Peak-10 minutes
- Inbound Lane, P.M. peak-9.4 minutes
- Outbound Lane, P.M. peak-8.5 minutes

---

[5] City of Winnipeg, TRAVEL AND DEMOGRAPHIC TRENDS 1962-1981, p. 23. This was the only estimation available since both routes are express routes and Winnipeg Transit keeps no accurate record of travel times of express routes. As well, observations made in the field backed up this estimation.

It must be noted that these time savings were achieved in ideal operating conditions with little interferance. However, even with an additional 5 minutes of waste programed into the schedule (to take into account changes in patronage, weather etc) the time savings would be adjusted to:

- Inbound Lane, A.M. peak-4 minutes
- Outbound Lane, A.M. peak-5 minutes
- Inbound Lane, P.M. peak-4.4 minutes
- Outbound Lane, P.M. peak-3.5 minutes

Based on these adjusted results, the time savings associated with the with-flow lane operating in both directions would be 9 minutes in both directions in the A.M. and 7.9 minutes during the P.M. peak periods. This is substantially more than the time savings associated with the 4 minute saving in the A.M. and 3.5 minute saving in the P.M. which would be attained by implementing a contra-flow lane in only the peak direction. As a result from purely a travel time saving perspective, the with-flow lane is clearly superior to both the contra-flow lane and the status quo.

### 5.3.2 Travel Time Regularity

The ability of transit lanes to regulate the travel times has been cited as a major advantage. Both alternatives would help to improve travel time regularity, but again the with-flow lane can be viewed as more attractive as it operates in both directions. Table 5 illustrates the variation in travel times observed during the field work, and compares these time to the results of the Transit Lane Simulation Model. To simplify the model, actual running times are used so variations in passenger loading times are not taken into account.

Table 5: Transit Running Times On Portage Avenue

| | Day1 | Day2 | Day3 | Day4 | Day5 | Av | Range | Model |
|---|---|---|---|---|---|---|---|---|
| A.M. Out | 21.1 | 19.3 | 20.2 | 18.6 | 21.3 | 20.1 | 1.9 | 18.2 |
| A.M. In | 23.0 | 21.3 | 19.4 | 20.7 | 21.2 | 21.1 | 3.8 | 19 |
| P.M. Out | 26.0 | 22.3 | 21.4 | 22.5 | 19.1 | 22.3 | 6.9 | 19.2 |
| P.M. In | 25.5 | 24.2 | 23.4 | 21.2 | 28.7 | 24.6 | 8.7 | 19.5 |

The table shows that travel times vary by as much as 8.7 minutes. It must be noted that these results are based on a small sample, and this range could actually be larger. The results of the model show that the implementation of a transit lane will result in better schedule adherence for transit vehicles. The four runs simulating the inbound and outbound lanes for the A.M. and P.M. peaks revealed a time differential of only 1.3 minutes. This differential could easily be attributed to the difference of stopping at one additional traffic light, and therefore should not be viewed as significant.

In a direct comparison it again is apparent that because a with-flow lane runs in both directions,there will be more regularity in travel times.

### 5.3.3 Financial Implications

Assessing the financial implications of each option requires two steps. Firstly the monetary costs of the alternatives will be explored, and then the expected benefits will be compared to these costs.

As stated earlier, it is assumed the actual implementation costs of each option will be comparable and the real difference will lie with the operating costs. Based on the results from other transit lanes it is assumed that the operating costs of a contra-flow lane will be at least $4,000 per month or $48,000 annually. This is considerably more than the operating costs of with-flow lanes as experience has shown that the operating costs of with-flow lanes are negligible.

It is important to note how the travel time savings will translate into economic savings. The standard rule is when the amount of time saved is equal to the headway eliminated from the round trip, the need for one bus is eliminated.[6] As a result is is important to note the peak hour headways of the three affected bus routes. The headways are:

- 11 Portage-4 minutes[7]
- 21 Portage Red Express-7 minutes
- 22 Portage Green Express-5 minutes

---

[6] Peter Hague Interview, August, 1985

[7] It is important to remember that as 11 Portage only runs along half of the lane, it will only be affected by half of the time savings.

For the with-flow lane, the expected time savings are expected to be 9 minutes in the A.M. and 7.9 minutes in the P.M. peak. The expected savings for 11 Portage buses are expected to be 4.5 and 3.9 minutes respectively for the A.M. and P.M. peak periods.

A comparison of these time savings with the headways, using the bus saving formula shows that the need for one bus on each of the three routes will be eliminated.

In terms of financial savings associated with the time savings, the Toronto Transit Commission in 1982 found that by eliminating the need for a bus in the peak hour $60,000 (82 $) can be saved in annual operating costs.[8] In terms of capital cost savings, the elimination of the need for one bus is now approximately $182,000.[9]

As a result, the implementation of a with-flow lane will result in a potential saving of $180,000 (82 $) in annual operating costs, as well as a $546,000 (86 $) capital cost saving.

For contra-flow lanes, the expected time savings are less than those expected from the with-flow lane. The expected time savings are 4 minutes in the A.M. and 3.5 minutes in the P.M. peak. A comparison of these time savings with the headways reveals that no savings in buses would be achieved through the implementation of a contra-flow scheme.

---

[8] IBI Group, RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES, p. 23

[9] Kent Smith Interview

From a fiscal perspective, the with-flow lane is clearly the more attractive alternative.

### 5.3.4 Effect On Automobile Traffic

If the automobile traffic along Portage Avenue was evenly distributed among the four lanes it would be fairly easy to ascertain the effect the removal of a lane would have on traffic flow. This is not the case however, as the traffic flow in the curb lane is much less than in the other three lanes.[10] This could be due to the high number of buses using the lane. Outside the CBD there are 39 buses per hour (or one every 1.5 minutes) running along Portage Avenue. The stopping of buses discourages other traffic from using the lane, therefore fewer automobiles use the lane. In the CBD, even more buses are in service, and as a result it is not uncommon for the entire curb lane to be made up entirly of buses.

The designation of the curb lane as an exclusive transit lane would have minimal impact on existing traffic flows as the curb lane is presently underutilized.

The contra-flow lane on the other hand would remove the median lane from the general traffic flow. The effect of this would be minimized if a parking ban was imposed in the off-peak direction. If this ban was put in place the number of lanes would not changed.

---

[10] Based on observations made during the field work.

In both cases the effect on other traffic would be minimal. It must be noted that any negative effect on automobile travel times could help to attract more riders to transit. The TTC, for example uses traffic congestion as an advertising tool. At known congestion points or rapid transit overpasses, signs are erected informing motorists that if they used the TTC they could be on their way home instead of being "stuck in the congestion".[11]

The implementation of a transit lane (in either form) would work in a similar way. In this case however the bus moving unimpeded through the traffic, while automobiles are stopped due to congestion might help to attract automobile users to transit.

### 5.3.5 Adaptability

This area of comparison refers to the ability of the transit lane to accommodate different levels of service.

In the case of a with-flow lane it is easy for express buses to by-pass local buses which are stopped loading and unloading passengers. With a contra-flow lane this is virtually impossible, as cones are set up to separate the contra-flow lane from the general traffic flow.

The only feasable alternative is to restrict the use of the lane to either express or local service. In either case it would mean that the transit lane would be underutilized, and likely not warranted based on the minimum lane utiliza-

[11] Interview with Peter Walton, Department of Urban Affairs, Province of Manitoba, Winnipeg Manitoba, July, 1984.

tion warrants.

Based on this, the with-flow lane is clearly the superior option as it not only accommodates the three main routes, but also other routes that only use small sections of Portage Avenue.

### 5.3.6 Accessibility and Safety at Bus-Stops

This comparison relates to the location of bus-stops, and passenger access. For with-flow lanes this is not a problem as there is no need to change the location of bus-stops. This is not the case with contra-flow lanes however as some bus stops would have to be located in the median. For this to be feasible the median would have to be at least 2.1 metres wide.[12]

Along the Portage Avenue median this width is attained except at points where the roadway expands to 5 lanes to accommodate left turn lanes. As a result bus-stops could only be located away from these intersections. Since passengers wishing to use transit must cross onto the median at intersections, this would require some form of walking path from the intersection to the bus-stop. This is not only inconvenient for the patron, but would also be expensive to maintain as both these walks and bus-stops would have to be maintained. As well, some people may feel uneasy about standing on the median due to drafts and sprays caused by passing vehicles. This could in some cases affect patronage

[12] This width is based in the minimum passenger platform size required by the Toronto Transit Commission.

as those with difficulty walking may decide not to transit. From this perspective it is felt that the with-flow lane is again the superior option.

### 5.3.7 Administrative Acceptance

The final area of comparison essentially deals with the probability of implementation. Due to the fact the with-flow lane was included as part of the Five YEAR CAPITAL PROGRAM, it is assumed the City of Winnipeg is fairly receptive to such a plan. The same cannot be said of a contra-flow lane. In discussions with officials of Winnipeg Transit it became apparent that the chance of Winnipeg Transit supporting the implementation of a contra-flow lane on Portage Avenue were virtually nil. As a result, from a practical stand-point, the with-flow lane is the best option.

Of course, it must be noted that administrative acceptance is of upmost importance if either scheme is to be accepted. As stated earlier traditional transportation planning is based on the efficient movement of vehicles. As a result, in some cases a basic change in this philosophy must take place before transit lanes would be successful.

## 5.4 Conclusion

The purpose of this chapter was to determine which option would best optimize the operating conditions of transit vehicles on Portage Avenue. The analysis clearly shows that the best alternative is the with-flow lane. The main advantage of the with-flow lane lies in the fact it can be implemented in both directions, while a contra-flow lane can only be implemented in the peak direction. This essentially means the travel time savings associated with the with-flow lane are almost double those of the contra-flow lane. This in turn leads to economic benefits as fewer buses will be needed to service the routes.

In terms of implementation it is also apparent that the with-flow lane alternative is superior. Not only is it less expensive to operate, but it is also the more efficient option as different levels of service can utilize the lane.

The transit lane alternatives matrix table illustrates how the two options compare in the 8 categories that have been investigated.

Table 6: Transit Lane Alternatives Matrix

+ denotes the superior option, - the inferior option and 0 a standoff

| | With-flow lane | Contra-flow lane |
|---|---|---|
| Travel time saving | + | - |
| Schedule regularity | + | - - |
| Capital cost | 0 | 0 |
| Operating costs | + | - |
| Impact on autos | 0 | 0 |
| Adaptability | + | - |
| Accessibility | + | - |
| Gov't Acceptance | + | - |
| **TOTAL** | **+6** | **-6** |

This comparison clearly shows that the with-flow lane is the superior option in six of the eight points of comparison. As a result,it appears that there is a greater potential for success with the implementation of a with-flow lane rather than a contra-flow lane.

# Chapter VI

## CONCLUSION

> Transportation must be viewed in a new light, not simply in terms of mobility but in terms of a better city.[1]
>
> --Wilfred Owen

Throughout the researching of this practicum it quickly became apparent that feasibility studies for most transit lane schemes do not exist and the "trial and error" approach is the most common form of analysis used in evaluating exclusive transit lanes. This is due in part to the non-capital intensive nature of transit lanes, and in many cases the consultants report would virtually double the implementation costs of a transit lane scheme.

The basic purpose of this study was to determine the utility of an exclusive transit lane on Portage Avenue in Winnipeg, and to determine if it would be a project worthy of Provincial Government financial support.

Chapter One introduced both the area of study as well as the methodology which was used to address the problem. In Chapter Two the existing literature was examined, and it became apparent that transit was an important municipal service and that transit deserves priority over automobiles.

[1] Owen, THE ACCESSIBLE CITY, p.51

The third chapter looked at the rationale behind transit priority measures and more specifically exclusive transit lanes. As well a few examples were examined, and it was determined that in certain cases exclusive transit lanes could lead to significant travel time savings for buses using the lane. Chapter Four looked at the existing transportation conditions on Portage Avenue and the applicability of either option in light of these conditions. The research showed that there was enough transit utilization along Portage Avenue to justify the implementation of either a with-flow or a contra-flow transit lane. In Chapter Five a comparison of the costs and benefits was made. On the basis of this analysis it was obvious that the with-flow transit lane was the superior option.

Based on the evidence presented in this report, it appears that Provincial money contributed to this project would be worthwhile. The economic analysis revealed that the transit lane could potentially eliminate the need for three buses in the peak periods, and the economic benefits associated with this saving would be an annual operating cost saving of $180,000 as well as a $546,000 capital cost saving. This is considerably higher than the expected $70,000 implementation cost.

As a result of the analysis it is recommended that the Province consider the cost-sharing of a with-flow transit lane on Portage Avenue. This could be done under the Urban

Transit Capital Grant Program which provides for Provincial funding of 50 percent of the net costs of approved bus purchases and innovative demonstration projects.

From a broader perspective, the methodology developed in this study could be used as a rapid preliminary estimate of feasibility for other proposed transit lane schemes.

## BIBLIOGRAPHY


1. Allen, G., HIGH OCCUPANCY VEHICLE LANES ON FREEWAYS:CURRENT STATUS IN NORTH AMERICA AND IMPLICATIONS FOR ONTARIO. Government of Ontario, (unpublished)

2. Altshuler, Alan, THE URBAN TRANSPORTATION SYSTEM, POLITICS AND POLICY INNOVATION. Cambridge:The MIT Press, 1979

3. Baerwald, John, TRAFFIC ENGINEERING HANDBOOK. Washington: Institute of Traffic Engineers, 1965

4. ____________, TRANSPORTATION AND TRAFFIC ENGINEERING HANDBOOK.Englewood Cliffs: Prentice Hall, 1976

5. Bakker, J.J., PUBLIC TRANSIT RIGHT-OF-WAY. Address given at the 1974 Annual Meeting of the Canadian Urban Transit Association, June 1974 (unpublished)

6. Bendixson, Terence, INSTEAD OF CARS. London: Temple Smith, 1974

7. Blumenfeld, Hans, THE MODERN METROPOLIS. Cambridge: The MIT Press, 1972

8. Button, K.J., THE ECONOMICS OF URBAN TRANSPORT. Westmead: Saxon House, 1977

9. Comp, MUNICIPAL PERFORMANCE REPORT. Volume 1, Number 6, 1975

10. Canadian Urban Transit Association, URBAN TRANSIT FACTS IN CANADA. Toronto: Canadian Urban Transit Association, 1984

11. Canadian Urban Transit Association and The Roads and Transporation Association of Canada, CANADIAN TRANSIT HANDBOOK(2nd ed.). Toronto: CUTA and RTAP, 1985

12. Daniels, P.W., MOVEMENT IN CITIES. London: Methuen and Company, 1980

13. Deluew-Cather Ltd., BUSLANE AND OPERATING STRATEGIES IN DOWNTOWN AREAS. Montreal: Transport Canada, 1978

14. _______________, OTTAWA RIVER PARKWAY CONTRA FLOW BUS LANES. Montreal: Transport Canada, 1979

15. Dickey, John, METROPOLITAN TRANSPORTATION PLANNING. Washington: Scripta Books, 1975

16. M.M. Dillon Ltd., EVALUATION OF EXCLUSIVE BUS LANE OPERATION:CENTRAL OTTAWA. Ottawa: M.M. Dillon Ltd., 1974

17. Guest, A.M. and C. Chuett, "Analysis of Mass Transit Ridership Using 1970 Census Data" in TRAFFIC QUARTERLY. Volume 30, Number 1

18. Hitchcock, John and Anne McMaster, THE METROPOLIS. Toronto: University of Toronto, 1985

19. Huxtable, Ada Louise, "In New York A Losing Battle"in NEW YORK TIMES, December 30 1969

20. IBI Group, RESERVED TRANSIT VEHICLE LANES AND OTHER TRANSIT PRIORITY MEASURES. Toronto: toronto Transit Commision, 1982

21. Kling, Christian, URBAN TRANSPORTATION PROBLEMS AND PROSPECTS. New York: Vantage Press, 1976

22. Leinwald, Gerald, THE TRAFFIC JAM. New York: Washington Square Press, 1969

23. Levinson, Herbert, and Robert A. Weant, URBAN TRANSPORTATION PERSPECTIVES AND PROBLEMS. Westport: Eno Foundation for Transportation, 1982

24. McLuhan, Marshall, UNDERSTANDING MEDIA, THE EXTENSIONS OF MAN. New York: McGraw Hill, 1964

25. Meyer, J.R., J.F. Kain and M. Wohl, THE URBAN TRANSPORTATION PROBLEM. Cambridge: Harvard University Press, 1965

26. Murray, J. Alex, MASS TRANSIT: THE URBAN CRISIS OF NORTH AMERICA. Windsor: Canadian American Seminar, 1976

27. National League Of Cities, TRANSPORTATION AND THE URBAN ENVIRONMENT. Washington: U.S. Department of Transportation, 1979

28. Ontario, Province of, PROVINCIAL SUPPORT FOR IMPEMENTATION OF RESERVED BUS LANES. Submission to Management Commitee, 1978 (unpublished)

29. Organization For Economic Co-operation and Development, TECHNIQUES OF IMPROVING URBAN CONDITIONS BY RESTRAINT OF ROAD TRAFFIC. Paris: OECD Group, 1973

30. ________________, BUS LANES AND BUSWAY SYSTEMS. Paris: OECD Group, 1976

31. Ottawa Carleton Transit Commision, STRATEGIC PLAN AND FINANCIAL FORECAST. Ottawa: Ottawa Carleton Transit Commision, 1984

32. Owen, Wilfred, TRANSPORTATION FOR CITIES. Washington:The Brookings Institute, 1976

33. Pushkarev, Boris, URBAN RAIL IN AMERICA. Bloomington: Indiana University Press, 1982

34. Rae, John, B., THE ROAD AND THE CAR IN AMERICAN LIFE. Cambridge: The MIT Press, 1971

35. Richards, Brian, MOVING IN CITIES. Boulder:Westview Press, 1976

36. Schaeffer, K.H.and Elliot Sclar, ACCESS FOR ALL. Middlesex: Penquin Books, 1975

37. Sewell, John, "The Suburbs" in CITY MAGAZINE. vol. 2, No. 6, January 1977

38. ___________, "Public Transit: A Primer" in CITY MAGAZINE. Vol.3, Nos. 4 and 5, May-June, 1978

39. Soberman, Richard and Heather A. Hazard, CANADIAN TRANSIT HANDBOOK. Toronto: University of Toronto- York University Joint Program In Transportation, 1980

40. Topp, R.M., EXAMPLES OF RESERVED BUS LANES. Responses to a 1971 questionaire (unpublished)

41. __________, RESERVED TRANSIT LANES. An address to the Annual Meeting of the Canadian Transit Association, June 1973 (unpublished)

42. Toronto Transit Commision, RESERVED BUS LANES IN METROPOLIAN TORONTO. A series of internal memos and reports, 1979, (unpublished)

43. United States Department of Transportation, URBAN CORRIDOR DEMONSTRATION PROJECT. Washington:Urban Mass Transportation Administation, 1974

44. Winnipeg, City of, PUBLIC TRANSIT STUDY, DOWNTOWN TRANSIT. Winnipeg: Winnipeg Transit, 1974

45. _______________, THE WINNIPEG REGIONAL TRANSPORTATION SYSTEM, EXISTING CONDITIONS. Winnipeg: Winnipeg Development Plan Review, 1978

46. ______________, PLAN WINNIPEG TRANSPORTATION COMPONENT. Winnipeg: Winnipeg Development Plan Review, 1980

47. _____________, TRAVEL AND DEMOGRAPHIC TRENDS 1962-1981. Winnipeg: Streets and Transportation Department, 1983

48. ____________, FIVE YEAR CAPITAL PROGRAM 1984-1988. Winnipeg: Board of Commisioners, 1983

49. ____________, TRAFFIC ZONE ATLAS. Winnipeg: Streets and Transportation Department, 1984

50. Winnipeg Tri-Level Commitee on Urban Affairs, NON-CAPITAL INTENSIVE TRANSPORTATION OPTIONS. Winnipeg: Winnipeg Development Plan Review, 1978