

THE POTENTIAL OF PASSENGER FERRIES IN AN URBAN TRANSIT SYSTEM

by

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ABSTRACT

The Potential of Passenger Ferries in an Urban Transit System

This thesis endeavours to explore the potential ridership and costs of a ferry service primarily oriented to commuters travelling between West Vancouver and the downtown core. Comparison of a Sea-Bus type ferry service with an equivalent bus operation indicates that the ferry would cost somewhat more, but this may be offset by environmental, social and land use externalities. The second conclusion is that transit policies designed to enhance the attractiveness of the ferry mode to daily commuters can generate substantial ridership in the case study situation. Finally, it becomes clear that a preliminary policy analysis can be made based upon an inexpensive, short and approximate set of calculations.

A review of the history of ferry service within Vancouver and other selected North American urban areas provides insight into the factors affecting patronage and a basis for assessing the claims made by ferry and transit advocates. Five patronage-oriented policy principles derived from this analysis are applied to develop a hypothetical concept of commuter ferry operation in the case study area. This plan is evaluated using available cost, ridership and modal split data to contrast three alternative scenarios, at the same level of patronage in the morning peak journey to work movements across the Burrard Inlet; ferry crossings only, bus crossings only, and a mixed ferry and bus situation.

In the case study area it appears that ferry transit is worthy of more detailed and definitive analysis. It is suggested that the same may be true of other North American metropolitan areas in which there are substantial commuting flows across major bodies of water.

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CHAPTER ONE INTRODUCTIONHistorical Aspects

During this century, increasing mobility has become a fundamental characteristic of urban living. Consumer demand has resulted in a series of technological innovations that in turn have altered the basic urban form. Cities became less centralized, and suburban residential areas became popular.¹ These ongoing events inspired the evolution of differing transportation planning approaches.²

Till the 1940's, fair emphasis was placed on public transit to move people. In the first two decades of the 1900's, horse drawn trams were being replaced by electric streetcars and rail operations. In the 1920's, streetcar and interurban rail services reached their peak popularity in all major Canadian Cities.³ In the late 1920's and the 1930's, transportation planning began to define road networks — arterial and residential service streets — and largely left the question of mobility to the streetcar systems.⁴ By the 1940's, conventional planning became oriented toward supplying route capacity to meet the anticipated growth in automobile travel. The emphasis in transit was to utilize new roads for motor or trolley bus operations.^{5,6,7} In the 1950's, comprehensive plans proposed creation of regional hierarchies of roads and expressway systems in metropolitan areas.^{8,9,10} This was the heyday of the 'utility engineering' approach to transportation planning. Public facilities were designated to meet forecasted demands and needs, with costs to be mainly covered by the users as a group, through some sort of road-users' tax. With the advent of large scale land-use transportation computer models in the 1960's, this process became even more refined.^{11,12,13,14} However, vehicle peak-hour congestion increased faster

than expected and road capacity did not keep up.

In the reality of the mid 1960's, social problems, economic concerns, ecological sensitivity and urban revitalization raised doubt in the public's mind as to the benefits and costs of comprehensive transportation projects. Very rarely did an engineering report on transportation assess the long term ramifications upon man and his environment. Proposals were moving too fast in a direction that many citizens were unsure about. Public pressure on the local political level often brought about abandonment of highway and bridge projects.¹⁵

Planners began to enunciate new direction of thought. One was the better utilization of existing road space, by encouraging higher car occupancy and bus use through special traffic privileges for them.¹⁶ Transit, which had declined since its peak in popularity, began to make a comeback with government assistance and the trend to public ownership in the 1960's and 1970's. The second trend in large Canadian metropolitan areas such as Montreal and Toronto was the re-establishment, expansion and revitalization of subway and commuter transit services. The smaller Canadian cities such as Edmonton and Vancouver, updated their bus systems and planned to integrate them with innovative transit links, in substitution for former bridge or highway projects.^{17,18,19,20} Selected road improvement programs, aimed at augmenting the quality of bus service were adopted as well.²¹ It is in this context that the passenger ferry re-emerges on the urban scene.^{22,23} It was identified by its advocates as a type of transportation infrastructure that compromised between the public's desire for better mobility and the parallel growth of anti-car, anti-freeway and anti-city demolition forces of the late 1960's and of the 1970's. At first, the private sector responded by pressing back into service the old ferries. The potential value of ferry operation was

recognized, and in a series of government take-overs the ferry became part of an integrated urban transit system of the mid 1970's.²⁴

The Thesis

The Concept: Ferry Revitalization

Urban over-the-water passenger transit is the main area of concern of this thesis. Many major metropolitan areas in North America are divided by substantial bodies of water that hamper access and mobility. The conventional wisdom called for bridging over (or tunnelling under) these barriers. Depending upon the engineering specifications, ordinary bridging solutions could incur high capital expenditures and potential adverse social impacts. The so called "ferry advocates" convinced planners and other public officials to consider waterways as facilitators, rather than barriers to urban mobility. Public waterways provide a vast amount of transit capacity limited only by the intensity of marine traffic. These advocates also pointed to the lower infrastructure capital costs associated with ferry systems.

The Problem: Potential for Ferry Transit

This thesis investigates the potential for ferry transit as a component of over-the-water transit in urban areas. It endeavors to analyze policies capable of generating substantial ferry ridership and then to compare the cost of establishing such a system with equivalent bus service. The policies in themselves emerge from a synthesis of historical changes in ferry use patterns, through service objectives suggested by the "ferry advocates" and general traditional transit operating principles affecting ridership on ferries and alternative modes.

The Methodology: Literature Review and Case Study

The problem is analyzed by a methodology that includes a synthesis of three processes. First, a literature review, supplemented by personal conversations and correspondence, is used to determine the historical development of past ferry and revitalized ferry service. Secondly, findings based on this information are combined with various concepts of transit operation, to produce a series of policies capable of increasing ferry patronage. Third, based upon the operating experience in San Francisco, a policy framework for West Vancouver is outlined, and compared to the cost of providing equivalent peak hour bus service. These operating costs are based upon unit cost models developed from data obtained from the Urban Transit Authority, the Greater Vancouver Regional District and the West Vancouver Municipal Transportation Department.

The Scope: Canada and the United States

This thesis limits its scope to urban commuter passenger ferries, on short haul (a trip less than 10 kilometers or 20 minutes depending on vessel technology), moderate capacity (300 to 500 passengers), peak-hour operation. As such, the policies are confined to those that cater to the journey-to-work trip purpose. Historical patterns and operating examples are limited to Canadian and United States experiences. Because a medium to long term planning horizon has been selected, there is only a general attempt at a quantitative estimate for ferry system configuration, technology assessment, model split evaluation and service costing. Figures are used only to relate the cost-effectiveness of ferry service as an alternative to an equivalent capacity bridge-bus operation. In the West Vancouver case study, the numerical analysis is limited to the morning peak period of roughly 7 a.m. to 9:30 a.m.

The Significance: Selection of Topic

The revitalization of ferry transit is a new, but increasingly popular phenomenon in transit planning. The work done on assessing the practical benefits and limitations of ferries as an alternative to bus transit is limited. Since some information about revitalized ferries has just recently become available from operating authorities, local planning departments and consultant firms, and because many metropolitan planning agencies are seeking to attract greater numbers of people to use transit, the review of policies capable of attracting patronage to ferry transit appears to be both a timely and a potentially useful exercise. Furthermore, the case study may have some practical significance for medium term transit planning in West Vancouver.

A Note on Terminology

The state-of-the-art in urban ferry systems has not yet crystallized. As a result, many terms have been developed to try to distinguish between the old and revitalized ferry systems. The terms, followed by their principle authors in parenthesis include: bus-on-water, (U.S. Department of Transportation), commuter ferries or ferryboats (Rearton, Spaulding, Harland, Kowlewski), ferry mass transit (Mullerhein and Laks), over-the-water transit or transportation (Krzyczkowski), Sea-Bus (B.C. Hydro Transit), rapid transit ferry (Bureau of Transit), waterborne transportation or transit (American Society of Civil Engineers) and Water-taxi (San Diego). For the purposes of this thesis, no differentiation will be made between old and contemporary ferries in terms of terminology. This thesis will use "ferry", "commuter ferry" or "ferry-transit" interchangeably.

Contents and Purpose of Each Chapter

Chapter two traces the rise and demise of urban ferries in a historical

perspective. Common trends are cited, categorized and explained using Canadian and U.S. examples. These trends are presented in terms of operating and service policy.

Chapter three continues in detail the historic perspective, discussing the ferry revivals of the past ten to fifteen years. The current planning context, including the issues raised by the advocates of ferry revitalization, is a prime topic that is dealt with. The common policy and operating trends are described.

Based on the historic reality of bridge competition, the factors that can draw ridership to ferries in parallel operation, are reviewed and discussed in Chapter four. The relative importance of the factors in adopting policies that will best attain the ridership goals of the ferry operating authority are indicated.

To ascertain if these policy considerations indeed have an effect upon determining the role of ferries as an urban transportation component, a brief case study of costs is reported in Chapter five. A ferry route that has been or may be under preliminary consideration -- between West Vancouver and Vancouver -- is the basis of the case study. The cost of peak-hour operation and amortized capital costs is compared to a bus equivalent bridge operation. Basically, this case study tests a selected policy framework against providing equivalent bus service.

Chapter six includes policy recommendations for a ferry to West Vancouver and general comments about the potential future role for commuter ferries in Canada.

FOOTNOTES

¹John A. Bailey, "The Problem of Mass Transportation in the Metropolitan Area", Evanston, Ill.: The Transportation Center at Northwestern University, p.2, (Xerox).

²The footnotes following 3 cite local examples of reports that exemplify the transportation planning approach mentioned in the text.

³Transport Canada, The Fundamentals of Urban Transit (Unedited Working Paper) (Ottawa: Department of Supply and Services, 1978), pp. 1-14 - 1-24.

⁴Harland Bartholemew and Associates, A Plan for the City of Vancouver, British Columbia, Including a General Plan of the Region, 1928, prepared for the Vancouver Town Planning Commission (Vancouver, B.C.: City of Vancouver, 1929).

⁵Harland Bartholemew and Associates, A Preliminary Report Upon the Major Street Plan and Transit Facilities, prepared for the West Vancouver Town Planning Commission (West Vancouver, B.C.: West Vancouver Town Planning Commission, 1946).

⁶Harland Bartholemew and Associates, A Preliminary Report Upon the Major Street Plan, prepared for the Vancouver Town Planning Commission (Vancouver, B.C.: City of Vancouver, 1946).

⁷Harland Bartholemew and Associates, A Preliminary Report Upon Transit, prepared for the Vancouver Town Planning Commission (Vancouver, B.C.: City of Vancouver, 1946).

⁸A Report on Burrard Inlet Crossings, by P.D. Willoughby, Chairman (Vancouver, B.C.: Committee on Burrard Inlet Crossings, 1954).

⁹Technical Committee on Metropolitan Highway Planning, A Study of Highway Planning for the Metropolitan Area of the Lower Mainland Area of B.C., Part II Freeways with Rapid Transit (Vancouver, B.C.: City of Vancouver, 1956).

¹⁰Technical Committee on Metropolitan Highway Planning, Summary Report (Vancouver, B.C.: City of Vancouver, 1956).

¹¹Wilbur Smith and Associates and Stanford Research Institute, Review of Transportation Plans for Metropolitan Vancouver (Vancouver, B.C.: City of Vancouver, 1964).

¹²Parsons, Brinkerhoff, Quade and Douglas, Inc., Vancouver Transportation Study (Vancouver, B.C.: Parsons, Brinkerhoff, Quade and Douglas, Inc., 1966).

¹³Swan Wooster-CBA, The Burrard Inlet Crossing, vol. 1, a report to the National Harbours Board (Vancouver, B.C.: National Harbours Board, 1970).

¹⁴Wilbur Smith and Associates, Downtown Transit Concepts, prepared for the Greater Vancouver Regional District (Vancouver, B.C.: Greater Vancouver Regional District, 1972).

¹⁵ V. Setty Pendakur, Cities, Citizens and Freeways (Vancouver, B.C.: By the Author, 1972), pp. 71 - 73, 79 - 80.

¹⁶ N.D. Lea and Associates, Measures to Improve Bus Transit Flow Across the First Narrows Bridge, prepared for the British Columbia Department of Highways (Vancouver, B.C.: N.D. Lea and Associates, 1967).

¹⁷ De Leuw Cather of Canada, Greater Vancouver Area Rapid Transit Study, prepared for the Joint Transportation Committee, the Greater Vancouver Regional District and British Columbia Hydro and Power Authority (Vancouver, B.C.: De Leuw Cather of Canada, 1970).

¹⁸ Greater Vancouver Regional District, Regional Transportation as a GVRD Function (Vancouver, B.C.: Greater Vancouver Regional District, 1971).

¹⁹ Brian Sullivan, Preliminary Plan: Immediate Improvements to Public Transportation in Greater Vancouver, prepared for the Greater Vancouver Regional District (Ottawa: Spatial Dynamics, Ltd., 1971).

²⁰ Greater Vancouver Regional District, The Livable Region 1976/1986 (Vancouver, B.C.: Greater Vancouver Regional District, 1975), pp. 21 - 25.

²¹ IBI Group, North Shore Transportation Study (Draft) (Vancouver, B.C.: IBI Group, [1978]).

²² Associated Engineering Services, Ltd. Burrard Inlet Ferry Crossing Study, a report prepared for the Greater Vancouver Regional District (Vancouver, B.C.: Greater Vancouver Regional District, 1971).

²³ S. Mullerheim and E. Laks, A Feasibility Study of Ferry Mass Transit Across Burrard Inlet (Vancouver, B.C.: By the Authors, 1972).

²⁴ British Columbia Bureau of Transit, Passenger Ferry Project Specifications (Victoria, B.C.: British Columbia Bureau of Transit, [1974]).

CHAPTER TWO THE RISE AND DEMISE OF FERRIESIntroduction: Why Search the Past?

Ferries have been known to mankind since antiquity. With every differing era, ferries performed an essential, albeit a changing role. However, one overall purpose has always been present -- the function of facilitating access and mobility. Whenever waterways severed land routes, ferries provided a slow, but an effective direct connecting link. Since early times, ferries have been considered to be a form of transit for people, goods and live stock.¹ As was not uncommon for other transportation mode junctions, ferry crossings often gave rise to new human settlements that allowed for permanency and regularity in ferry operation. Many cities, including New York, Paris and London owe their existence and their commercial development to ferry crossings.²

When Europeans came to North America, ferries left their mark in the names of many locations -- Dobbs Ferry, New York; Harpers Ferry, West Virginia; Martins Ferry, Ohio; Donahue Landing, California; Gibson's Landing, B.C., to name a few. As a result of colonial economic growth, ferries took on the responsibility and role of linking regional centers with their hinterland settlements and resource towns -- the mills on the north shore of Burrard Inlet with Vancouver, the logging resource town of Dartmouth with the British naval base at Halifax. But at the turn of this century, these disperse settlements slowly became interwoven into a unified urban form. The ferry operators responded by providing regular and frequent crossings oriented to the pedestrian, and later to the auto user. In the waining years, operations again altered, promoting car only or passenger only service on limited routes. However, ferries were unable to find a niche in the urban transportation system upon the introduction of cars and building bridges.

Many ferries ceased to exist as people shifted to other modes of private and public transit. Ferry service deteriorated drastically, forcing government intervention in the industry.

From the time ferries were established in North America, it is evident that operations underwent a series of changes to cope with the changing urban milieu. The fact that some ferries survived and continued to compete with parallel bridge systems while others did not survive, indicates that it was necessary to address some crucial factors through appropriate policy and/or service changes in order for a ferry to avoid demise in bridge competition.

The purpose of this chapter, therefore, is to review the historical development of ferries in Canada and the United States, and infer what critical elements and policies controlled the success and failure of ferries in parallel operation with bridge links. In order to do this, the history of ferry operations is discussed in five specific periods of operation:

- (1) initiation of service; (2) growth and competition; (3) bridge competition;
- (4) the war time interlude, and (5) the final decline.

Initiation of Service

The earliest ferry routes by European settlers in North America, were established under colonial rule. The initiation of service came by order or authorization of the local or royal government. In 1635, the Massachusetts General Court authorized a ferry to cross the Neponset River between Boston and present day Quincy.³ The Common Council of Hartford directed that a ferry be operated across the Connecticut River to East Hartford in 1681.⁴ The oldest ferry system in Canada, between Halifax and Dartmouth, was established by the command of Governor Cornwallis on February 3, 1752.⁵ The British Government in Manhattan granted a charter for ferry operation

between Staten Island and Manhattan in 1712.⁶ These early systems had similar intent. First was social responsibility, based on the law of good government, to provide access for local citizens, travelers and traders. Secondly, ferries had a military intent. Sites isolated by natural water bodies were easily defendable from Indian attacks or rival royal armies. Ferries offered transportation of troops and supplies, allowed for stronger defences and became strategically important military links. Third was the commercial interest of the ferries. Ferries permitted colonial commerce to flourish, by making human and goods movements easier. Interactions between regional centers and their resource hinterlands not only became possible, but became much larger in geographic scope.

Ferries initiated by government authorization generally had the safe-guard of state intervention to assure safe, steady and to some extent, dependable operations. For example, in 1715, the Common Council of Hartford Connecticut responded to public dissatisfaction with ferry service, by acquiring and performing the operating task.⁷ After a series of ferry accidents, the City of New York purchased the Staten Island Ferry System in 1905.⁸ In 1890, sixteen years following its incorporation, the City of Dartmouth bought out the Halifax and Dartmouth Ferry Company, placing it under the operation of the Dartmouth Ferry Commission.⁹ An even handed rule of providing effective ferry service at a reasonable cost to local citizens became the general operating policy.

A number of ferry routes had their origin with independent operators. Independents were often distinguished by their unreliable business character. Operations were seldom regular, usually by appointment, and at a low level of comfort or convenience. Independents could terminate their service as suddenly as it was commenced. Prior to the establishment of regular service in areas such as the Burrard Inlet and San Francisco Bay,

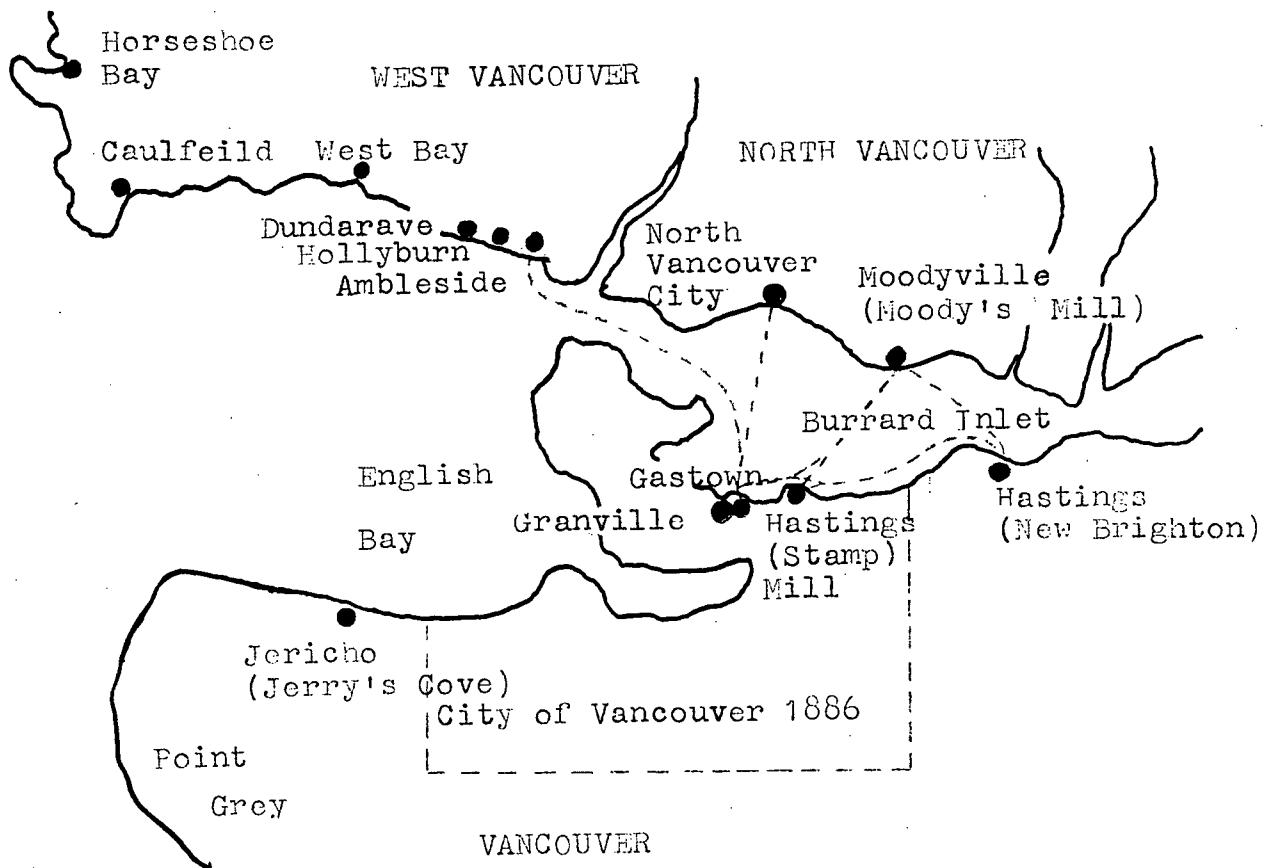
numerous individuals provided a more or less fixed route service upon demand or appointment. With the coming of the California Gold Rush, Captain Thomas Gray provided ferry service between San Francisco and the settlement or encampments on the east shore of the Bay in 1850.¹⁰ In Vancouver, the first ferry route appears to have been rowboat service between Brighton and Moodyville.¹¹ (See figure 1) Prior to 1890, a few chartered vessels operated between the north and south shores of the Burrard Inlet. The most famous independent, John Thomas, also known as "Navvy Jack", provided ferry service in 1886. He was followed by others, mainly supply carrying vessels, that shuttled between Moodyville, Hastings and Granville.¹² Similarly in West Vancouver, semi-weekly service between Hollyburn and Vancouver was begun by John Lawson, during the first decade of the 1900's. In 1909, Lawson's service was replaced by W. C. Thompson's unscheduled, daily service from the Dominion Wharf at Hollyburn.¹³ With the incorporation of various municipalities in the Burrard Inlet area, their delegated power to regulate ferries brought the days of the independents to an end.¹⁴

Ferry operation by the independents portrays a vivid contrast to operations initiated by government decree. They did not have to live up to any government regulations or community goals. Their services were very arbitrary, infrequent, often unsafe and unequitable. Independents in urban areas disappeared as a result of government intervention by way of business regulations, route franchising or by setting minimum schedule requirements.

The third category of ferry service initiation, was based on entrepreneurship. Entrepreneurs raised the image of the ferry industry from a "fly-by-night" operation, to one of a rather professional, reliable and convenient cross-water transportation business. During the 1800's entrepreneurs brought about the largest scale of ferry activity ever achieved in most North American cities. Such areas as the Puget Sound, San Francisco and the

FIGURE 1

Early Settlements and Ferry Routes on Burrard Inlet.



Adapted from:

Walter G. Hardwick, Vancouver (Don Mills, Ont.: Collier-MacMillan Canada, Ltd., 1974), p. 12.

Raymond Hull, Vancouver's Past (Vancouver, BC.: Gordon Soules Economic and Marketing Research, 1974), pp. 23, 79.

Alan Morley, Vancouver. Vancouver, B.C.: Mitchell Press, 1974, p. 8.

Margaret A. Ormsby, British Columbia: A History (Vancouver, B.C.: Evergreen Press, 1958), p. 237.

Ports of Boston, New York and New Orleans had numerous companies and ferry routes created. San Francisco had as many as fifty to sixty ferries, belonging to some thirty companies, operating simultaneously on the Bay.¹⁵

The entrepreneurs could be classified in two ways: by the source of their capital investment and by the service form. The typical ferry investors were either based with local or with outside interests. Locally operated ferries tended to cater to the local, smaller needs in water transportation of each community. For example, the ferry service between Vancouver and West Vancouver was initiated by the West Vancouver Ferry Company in 1909.¹⁶ The service was based on the policy of providing West Vancouver residents with convenient and direct pedestrian only ferries.¹⁷ Outside operators were generally large investors or railway companies. They operated ferries primarily to shuttle their trains into a sea port for transfer of goods to and from ships. Numerous companies established ferries for this purpose on San Francisco Bay and on the waters off of New York Harbour.^{18,19} The minimization of capital and operating costs was the policy basis for selecting the ferry over circuitous rail access to the seaport. Other railway companies with local transit services operated ferries to carry their trams, and later street cars. In 1881, the horse drawn tram between New Orleans and West Bank (Algiers), utilized a ferry for exclusive service into the downtown.²⁰ Some outside operators compromised to allow passengers to use their train or supply ferries. From 1888, the same was true in Vancouver, when the Steamship Senator began calling upon North Vancouver on its way with pulp mill products from Moodyville to Vancouver.²¹ Those services instituted by entrepreneurs in the later 1880's and early 1890's, were motivated by the profits and land development. In 1886, Story and Bobcok established a ferry service between San Diego and North Island (Coronado), to "provide access to guests and prospective land buyers,"²² near their island

resort-hotel. Provision of transport between the fledgling town of Coronado to the mainland was but the last concern. Hence, entrepreneurs initiated one of three policies that dictated the service form: ferries only to move goods -- out of economic frugality; ferries for both passengers and goods -- out of social necessity and ferries for the exclusive movement of people -- out of regulatory stipulations or due to secondary business ventures.

Growth and Competition

There are a number of distinguishing factors between the first and in the second phase of ferry history. The foremost difference is the establishment of regularly scheduled ferry service on fixed routes. In Vancouver, regular ferry service appears to have been established by 1900, though it is not entirely clear within the literature by which operator and exactly in what year. According to Woodwards-Reynolds, the first "scheduled" ferry service was provided by the Moodyville Steam Ship Company, beginning in 1888.²³ Burnes cites evidence that the Union Steam Ship initiated the "first regular ferry service", in 1893.²⁴ While Barr contends that the first vessel to "operate exclusively" to North Vancouver was called the Norvan, commencing operation in 1900.²⁵ Regular, year round ferry service became instituted between Hollyburn (West Vancouver) and Vancouver by John Lawson, W. C. Thompson, Robert MacPherson and John Sinclair in the West Vancouver Transportation Company, on November 8, 1909. By 1911, the company ran ferries on fixed routes between Vancouver Wharf, English Bay, Hollyburn, the Great Northern Cannery and Caulfeild.^{26,27} In Boston, daily commuter service between Hingham and Boston started in 1819.²⁸ In the New York City area, regular service began in the same year between Manhattan and Shewsbury, New Jersey.²⁹ The first regular scheduled ferry service in San Francisco was between Sausalito and San Francisco in 1868.³⁰

The second distinguishing factor of this period is the rise of operators that stressed only car and/or passenger service. Cargo and trains became the domain of a specialized branch of the ferry industry. The first such separate ferry service for passengers on the Burrard Inlet, occurred in 1900 on the North Vancouver route, followed on the West Vancouver route in 1909. Double ended car ferries did not appear on the Inlet until 1904, on the North Vancouver route.³¹ Pedestrian operations were begun in San Francisco by the Sausalito Land and Ferry Company on October 1869. Two car carrying ferries were placed on this route in 1877.³² In San Diego, the first ferry was a barge pulled by a yacht. It was replaced four months later with a "three horse and buggy capacity" ferry.³³

The third distinguishing factor was the role of growth and competition. In Dartmouth, two way competition existed in 1797 and three way competition started in 1817 with the formation of the Halifax Steamboat Company by influential Halifax businessmen in 1815. Competition effectively ended with municipal take-over under the Dartmouth Ferry Commission. It was operated by this authority until 1958, when ferry operating responsibilities were directly assumed by City Hall through the Dartmouth Ferry Committee.³⁴ In Vancouver, competition was limited to the North Vancouver route, and ceased altogether upon municipal acquisition of the ferry systems. Some route competition existed in the years between 1888 and 1908. The Moodyville Saw Mill Company, operators of the Moodyville Steam Ship Company (Ltd.), competed with a ferryboat run by Taylor and with the terminating portion of the Victoria-Vancouver-Moodyville route of the Canadian Pacific Steam Ship Company.³⁵ Ratepayer demands for direct service to Vancouver from North Vancouver rather than from Moodyville, led North Vancouver Municipal Council to contract the Union Steam Ship Company to commence daily service. The company backed away from contract obligations in 1900.³⁶ In 1903, after three

years of continuing ferry competition problems, Council sanctioned A. St. George Hummersley to establish the North Vancouver Ferry and Power Company.³⁷ His service was rivalled by two locally owned and operated ferry services.³⁸

After incorporation of the City of North Vancouver in 1907, the city itself assumed full responsibility for trans-inlet ferry operation. It acquired Hummersley's company in 1908, reorganizing it as a public utility under the name of North Vancouver City Ferry, Ltd. It was operated this way until 1913 when public dissatisfaction over the quality of service led council to purchase and operate the ferry by a committee of Council. The West Vancouver Ferry Company was also acquired by government. Upon the incorporation of the District of West Vancouver in 1912, ownership and operation passed to the district.⁴⁰ Since the ferry had been purchased by the people in the area in 1910, the district chose to operate the ferry as a stock company with the Council as directors and the citizens of the new district as stock holders.

After 1916, however, the civic transportation department operated the ferry.⁴¹ For both systems, growth was limited to fleet size and competition was effectively non-existent. The North Vancouver Ferry started with two vessels in 1908 and added one ferry in 1911⁴² and one more in 1931.⁴³ With routine replacements, the fleet never exceeded four ferryboats. The West Vancouver ferry operated three ferries to 1935, but only two afterwards.⁴⁴

Areas having a higher degree of competition and growth include Boston and San Francisco. The greatest ferry activity in Boston took place in the 1800's,⁴⁵ or more specifically in the first half of that century. Peak ferry activity in the San Francisco Bay area occurred from the turn of the century, through the early 1900's. As indicated on the map, (figure 2) some 27 companies operated up to 20 competing routes to and from San Francisco.

An adjunct to competition became the profit motive. There was persisting speculation, frequent mergers and feverish sellings of ferry operations

FIGURE 2 San Francisco ferry routes

See: G. H. Harlan, San Francisco Bay Ferryboats
(Berkeley: Howell-North Books, 1967), p. 14.

and franchises. Until the decline period, ferry operators could always find a buyer for their operations, especially on the lucrative routes. For example, the history of the San Francisco to Oakland ferry consisted of a series of mergers, take-overs and purchases in its century of operation.⁴⁶ In 1852 the route franchise was given to the Contra Costa Steam Navigation Company. It lost out in competition with San Francisco and Oakland (SF&O) Railroad, that combined Contra Costa's operation into its own rail operations in 1857. The SF&O Railroad was in turn purchased by the San Francisco and Alameda (SF&A) Railroad seven years later. This purchase had been encouraged by the Central Pacific (CP) Railroad which at the same time was actively buying SF&A Railroad stock. In 1868, CP Railroad gained a controlling interest in stock, taking over SF&O Railroad ferry operations in 1868. CP Railroad ceased to exist in 1885, and was taken over and re-organized by Southern Pacific (SP) Railroad. Then in 1887, SP Railroad acquired by merger a number of smaller ferry and commuter rail operations. In 1929, SP Railroad transferred its car ferry operations to a consortium company -- the Southern Pacific-Golden Gate Ferry, Ltd. -- in order to compete with the new Bay Bridges. SP Railroad operated until 1958. On the east coast of Canada, the Halifax Steamboat Company joined forces with one of its two competitors in 1827. By 1833, the company virtually controlled cross-bay traffic, having driven out of business their major ferry route competitor.⁴⁷

The fourth factor was related to the similarity in the expansion policy between ferry and rail transit companies. The typical rail company, such as the B.C.E.R. in Vancouver, placed tracks in potential growth areas, on lands it already owned.⁴⁸ The operation of an effective transit system, whether on land or water, was a secondary concern to maximizing profits and returns on capital investments. In West Vancouver, the land boom of 1907 through 1914 brought pressure for better, direct access. The Dominion

Government responded by constructing a pier at Hollyburn in 1808. A year and a half later, the West Vancouver Transportation Company established ferry service. "The promoters of the ferry company did not expect it to be a paying proposition for the losses entailed in its operation were to be offset by the increased value of their real estate in West Vancouver."⁴⁹ Similarly in San Francisco, the Sausalito Land and Ferry Company primarily operated to attract land buyers to a subdivided ranch which, incidentally, belonged to one of the company owners. In exchange, buyers could use the ferry on a priority basis over other users. According to Harlan, "the company had more interest in selling land than operating an effective ferry service."⁵⁰ In 1875, seven years from its founding, the company relinquished its rights of ferry operation to the North Pacific Railroad Company.⁵¹ In 1920, the Golden Gate Ferry Company prided itself on the fact that profits had grown at a rate of 20% a year on their capital investments.⁵²

Towards the middle of the growth and competition period, a fifth distinguishing factor surfaced. Ferry operators adopted the policy of expanding their ridership catchment area by operating, acquiring or arranging to be serviced by rail and bus transit lines. Locally, the Pacific and Great Eastern Railway agreed to operate a commuter rail line from Horseshoe Bay to the ferry slip in West Vancouver between the years 1914 and 1928. Beginning in 1916, the municipality operated a feeder bus line to the ferry as well.⁵³ By the turn of this century John Spreckels bought out the San Diego and Coronado Ferry from Story and Babcock. He also operated the rail and streetcar networks on both sides of the Bay, and in later years, the San Diego Transit Company.⁵⁴ The rather lengthy life of this ferry (1886-1969) can in part be attributed to the integrated transit-ferry service that was provided by the San Diego and Coronado Ferry Company. In San Francisco, the North Pacific Coast Railroad linked their Marin County

interurban with their newly acquired Sausalito Ferry. In a joint venture between South Pacific and the Santa Fe Railroads, several smaller rail lines were merged to link into the railroad's converted passenger operations.⁵⁵

The last distinguishing factor, especially in areas with minor government intervention, was route duplication. The most lucrative ferry corridors in San Francisco were across the Golden Gate to Marin County and between San Francisco and the Oakland-Alameda areas. Every major operator had terminals and routes in these two corridors.

In conclusion, the ferry industry had reached a maximum level of stability during the latter period of the growth and competition phase. This stability, however, quickly disappeared due to the rapid increase in faster and cheaper alternative modes for commuter transit. It will also be shown that technological advances in bridge construction engineering eliminated the indispensability of ferries in over-the-water transportation. Specifically within this historical phase, the industry was governed less by traditional competitive forces, as the instability grew. Competition became transformed into strong, negative rivalries that ultimately led to a declining level of service and quality to the commuter. That is, in the struggle by each company to contain their own, individual ridership markets, the degree of customer choice in routes, time and frequency fell victim to cost and service restraints. Route duplication, especially on the lucrative ones, further denied the commuter's choice by reducing the number of trip opportunities, at a time when public sought greater mobility. In another respect, the profit and land development motives had conditioned the industry to create demand rather than responding to it. On the one hand, ferry operating losses could no longer be offset by the sale of expensive land in the terminal vicinity. The only land available was far removed from the pecuniary effects flowing out of choice location. On the other hand,

the desire to extend transit links into new areas to achieve the same sort of inflated land value gains, failed due to two reasons. First, this often resulted in encroachment upon another company's traditional passenger shed; and second, the trend to lower density development just could not be served efficiently by rail transit. In the larger picture, the emphasis on adding feeder routes became less and less cost effective in increasing ferry patronage. Over the long run, preoccupation with building of feeder services caused an overextension of capital resources -- and the inability to pool enough funds to facilitate ferry system improvements. The frequent mitigating response included mergers, partial route termination or eventual bankruptcy. The public's exposure to new land-based transit systems, coupled with the rising number of private automobiles, the provision of better roads, construction of bridges and the general economic prosperity, totally eroded the ferry industry's natural monopoly on over-the-water transportation movements.

Bridge Competition

The advent of bridges brought about three planning strategies from which policies were adopted. First, some operators began to contemplate what operating changes bridge competition would necessitate, with the first serious discussions of bridge construction and access highway construction. A second group did not start to consider potential operating changes until construction was well under way or completed. The third group reasoned that bridges were a substitute for the ferry system, so they planned the best way to terminate service and dispose of capital investments.

However, the period in which serious talk about bridge building began also had a bearing on the attitude of ferry operators. As early as the 1920's, most urban areas had comprehensive transportation plans, directing the

attention of policy makers to major road, highway and bridge construction schemes. These hints turned into serious talk, at different times for different metropolitan areas. It was not until the 1930's that bridge building plans were drafted in Vancouver and San Francisco. The intent to bridge Halifax Harbour came towards the end of the 1940's. With regards to the New Jersey-New York City corridor and the Verrazano-Narrows Bridge, serious talk materialized into a plan in the late 1950's. Similarly, it was the 1950's for the Greater New Orleans Bridge. For San Diego, it was about 1960 that a bridge to Coronado was proposed. Talk leading to the construction of a parallel bridge in New Orleans began towards the end of the 1960's. A third crossing for Vancouver was adopted as policy in the late 1960's as well.

It is therefore evident that the strategy toward bridge competition was dependent on prevailing social, political and economic forces. A crucial factor was the attitude of local, regional and federal governments toward the role of ferries and bridges. If government policy called for immediate or gradual change in emphasis to a car and bus oriented transportation network, ferry operators had no recourse but to terminate service. A policy of either ambivalence or support reinforced the first two potential planning strategies. A most significant external factor was World War Two. As will be discussed more fully in subsequent sections, the War brought about a resurgence in the use of public transit, including the ferry. Both on the initiative of ferry operators and with Government aid in the name of the war effort, ferry systems that did not terminate service responded by upgrading their systems. In the period of bridge competition that followed the War, these systems were more likely to compete successfully, delaying the process of decline. Therefore, consideration of this period is either directly coupled to the final decline and demise of service, or indirectly

coupled with an intermediate phase of wartime operation.

Despite these intervening externalities, three aspects tended to permeate this phase of ferry history. The first was serious discussion among public policy makers, about bridge construction. The second appeared as a typical ferry operator's response: service curtailment, stream-lining of operations and often radical changes in operating intent. The third was the "fare war", that resulted in financial difficulties for both toll bridge and ferry operators.

Serious discussion of bridge building was often associated or just preceded the formation of government bodies to oversee bridge construction plans. In Halifax, the Dartmouth-Halifax Bridge Authority was established five years before construction of the MacDonald Bridge;⁵⁶ The Mississippi River Bridge Authority was formed to oversee bridge construction plans in New Orleans;⁵⁷ the Golden Gate Bridge was preceded by the incorporation of the Golden Gate Bridge and Highway District in 1928;⁵⁸ the San Diego-Coronado Bridge was planned by a special branch of the California Department of Transportation.⁵⁹ Vancouver was an exception to this rule. The Lions' Gate Bridge was built and opened for use in 1938, by a division of British Pacific Properties, a development company largely owned by the Guiness family. The purpose of the bridge was to provide access to property BPP had purchased for development in West Vancouver.⁶⁰

Service curtailment usually took the form of reduced service frequency, elimination of non-peak hour sailings, and removal of older, more labour intensive vessels from operation. But curtailment itself was accompanied by one of two types of service restructuring policies. First, some routes were converted to car only operation. The assumption was that ferries had to compete with bridges on an even footing, which meant catering to automobiles. In 1955 on the North Vancouver route, passenger accommodations on the

ferries were removed to make more room for cars.⁶¹ Somewhat earlier, in 1929, San Francisco took this process one step further. Three major car carrying ferry companies not only converted ferries to car only use, but consolidated their routes, vessels and schedule of operation, to take advantage of economics of scale in cost and service capacity. They concentrated their efforts on routes paralleling the Golden Gate and Richmond Bridge corridors. In reference to this consolidation, one author writes, "The Golden Gate Ferry Company was absorbed in an organization which handled masses of vehicles in proportions that only bridges could supercede."⁶² Because the ferries were still directly linked to the regional road systems, they operated successfully for a short time following the first use of the new bridges.⁶³

The second strategy which followed bridge opening were price reductions that caused a "fare war". Ferry operators in San Francisco between 1936 and 1940 tried to undercut crossing tarrifs and commuters returned in mass to the systems. However, bridge operators, and by extension politicians felt protection of the public's investment in the bridges was imperative. Based on this premise, ferries were deemed to be no longer in the public's interest, and bridge operators countered every fare reduction with one of their own.⁶⁴

The second type of service restructuring emphasized pedestrian oriented service, rather than conversion to car systems. The loss of auto patrons to the Verrazano-Narrows Bridge and the metropolitan New York expressway system brought a 1974 decision to replace three of the old ferries on the Staten Island run by passenger-only vessels, with a capacity of 6000 passengers each.⁶⁵ In Halifax, the City of Dartmouth replaced their fleet with two new passenger-only ferries in 1956, following the opening of the MacDonald Bridge.⁶⁶ In these two instances, the ferries continued to

compete successfully with bridges because they had local government support. However, in San Francisco, where ferry systems did not have the same degree of support of the local and regional authorities, even passenger-only ferries failed. They managed to outlive the car ferries on the Sausalito route by just two years, with termination of passenger-only service in 1941.⁶⁷

Favourable government policy was coupled with effective forethought in the case of the Halifax-Dartmouth Ferry. In addition to handling only foot passenger trips, the commission replaced its two ferries with ones that were less labour intensive.⁶⁸ As a result, the Halifax ferry is still in operation, with plans for expansion.⁶⁹

A significant fact that cannot be overlooked is the role of bridge-bus competition with the ferry systems. Ferries had always been dependent on trams and streetcars, as passenger feeders to the ferry slip. Streetcars were a fixed system, and little concern was given to the possibility that route structures would change. By necessity, they would always direct passengers to the ferry. In reality, three problems took pedestrian-only operators by surprise: first, the sudden popularity of personal transit by car; second, the actual diversion of streetcars and inter-urbans onto bridge structures; and third, the abandonment of rail public transit and the introduction of motor buses and, after the war, trolley buses. Transit was no longer forced to keep to traditional routes that feed the ferries, but could proceed across a bridge to its destination. Ferries could not compete with a form of transit that required no transfers, was highly connective, and took no longer than the previous ferry augmented service.

Wartime Operations

Ferry operations in North America followed the national trend in

transit. (Compare figures 3 and 4) Ferry systems had peak ridership occurring during or just after the end of hostilities. In order to meet public demand, ferry operators expanded their fleets and operating hours. Halifax increased its fleet from three to four boats, operating around the clock between 1938 and 1943.⁷⁰ North Vancouver doubled its fleet size in 1942 to four ships, and by the end of the war had replaced its two older ferries.⁷¹

The period of war time operation was not only an interlude from bridge competition pressures, but it allowed for ferry operator to upgrade and improve services, operations and facilities. Sufficient action in this period strengthened the position of the ferry system following the resumption of bridge competition following the War. A number of positive trends developed in this period. First of all, vessel and terminal improvements were made to reverse deterioration and to accommodate the new level of patronage. Many of the costs were directly or indirectly financed by government as part of the war effort. Secondly, the heavy patronage levels allowed for the detection of problems and defects with the existing ferry systems, forced to function as a "bus-on-water", led to realization that vessel design and physical performance were inadequate. Third, operators were faced with more intense peak-hour directed demands. This exposed deficiencies in terminal access, local pedestrian circulation and system breakdown in congestion. Finally, the importance of the commuter's value of time, the inconvenience of mode transfers, and rising public expectations for transit comfort pointed to the inherent weakness of ferries as an isolated element in a regional transportation system.

The net, long term result of these actions, or lack of actions during the wartime period can be partially illustrated in a comparison between the North Vancouver and West Vancouver ferry systems. The North Vancouver

FIGURE 3 Annual Number of Person Crossing
Burrard Inlet by Various Facilities
1939 - 1953

See: A Report on Burrard Inlet Crossings, by P. D. Willoughby,
Chairman (Vancouver, B.C.: Committee on Burrard Inlet
Crossings, 1954), Diagram 1.

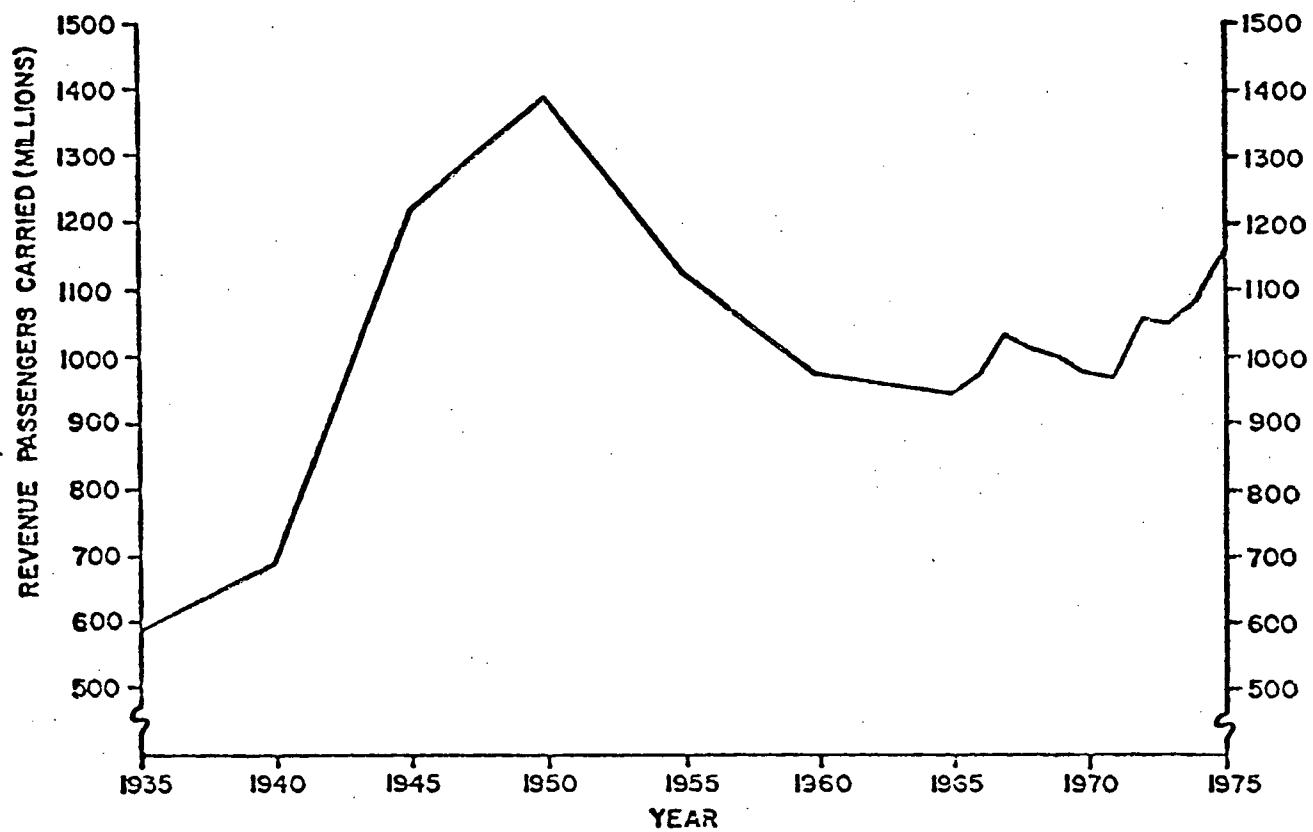


FIGURE 4 Canadian Transit Ridership 1935 - 1975

Source: Handout notes by T. Parkinson, Planning 505, 1977.

system underwent major vessel related improvements, while the West Vancouver system effectively underwent no upgrading of any type. By reviewing the trends shown in figure 3, one sees that peak ferry ridership on the Burrard Inlet was reached in 1943, when just over eight million passengers were carried by the ferries. This diagram also indicates that the West Vancouver ferry did not sustain any growth of ridership following the war, while the North Vancouver system had ridership in excess of pre-War levels to about 1950. Similarly, the lack of improvements led the West Vancouver system into an early decline and swift demise. Another positive aspect of the North Vancouver system was its ability to cater to a substantial and specific market -- workers at the Burrard ship yards.⁷² Since ship building at the yards continued for some years following the War, the North Vancouver system had a steady source of riders. The inability of the West Vancouver Ferry to cater to a specific market segment, or in fact, the lack of a sizable market in West Vancouver, spelled demise. A complicating factor was the "one way" nature of the system following the war. The Vancouver terminal was almost one mile from the centre of downtown job activities. This location was ideal for north-bound travellers since they could avoid the downtown. But for North-shore white collar workers, this acted as a deterrent to ferry use. The West Vancouver ferry could not compete in terms of time, convenience or proximity of trip ends with car travel or direct bus service.

Decline and Demise

The decline in ferry service has been largely coincident with the massive shift from public transit to private car use during the latter portion of the bridge competition phase. It was often a rapid decline with the termination of service occurring soon after the bridge and associated

highways were opened for public use. The decline followed separate paths, depending on whether operators pursued a pedestrian only or car only service, the attitude of local and regional policy makers regarding ferry operations, the strength of bridge diversion on person trips, and the extent of the growing urban bus system. Ferry operations that did not initiate service either under government or entrepreneurship, operate during World War II, convert to passenger only operation and come under direct supervision or control of government, faced demise under bridge competition. All other ferry systems had their decline fueled and demise guaranteed by two broad operating problems. First, ferry companies were using ferryboats that had outlived their capital lifetimes, by being economically, operationally, technologically, physically and/or otherwise obsolescent. These ferries were part of a technology that was one or two generations behind in time. Furthermore, the terminals and wharves had long since become antiquated. Their location relative to newer growth centres in the downtown reduced their proximity and accessibility for the average commuter. The second problem dealt with insufficient capital for investment in new ferries and terminals. Bridges diverted so many paying patrons that there was inadequate revenue for day-to-day operations, let alone upgrading and reinvesting. Some operators had over extended themselves through creation of rail feeder systems. Much of their capital from earlier profits were tied up in these ventures. Only the North Vancouver, Halifax and other publicly operated systems had the luxury of government subsidization to mitigate this financial problem.

There are a number of general events that distinguish this phase from the period of bridge competition. Often the first factor was the drastic decline in patronage, accompanied in some systems with fluctuations out of the "fare war". The decline, in competition with bridge operation

in Halifax, led one captain to remark:

Pedestrian traffic has dropped from something near ten thousand people a day to less than six thousand and it now takes a week to carry the same number of cars and trucks we used to carry in a day (before the bridge was opened). 73

As for the West Vancouver Ferry, following the lifting of the Federal Government's wartime bridge use restrictions in July 1945, Bartholemew observed that

Almost over night, bus traffic across the [Lions' Gate] Bridge, broke all previous records, but the ferry fell to an all-time low. 74

The decline can also be demonstrated in terms of underutilized ferryboat capacity. From figures in the Burrard Inlet Crossing Study of 1954,⁷⁵ just over half of the peak-hour direction capacity for cars or pedestrians was used. This was in stark contrast to the car line ups on Lonsdale, just some ten to fifteen years beforehand.

Along with the general decline in patronage, off-peak hour demand for the ferry became very light. This led to a second set of distinguishing events, gradually diminishing operating frequency and abandonment of all day service. After 1955, late hour service was cancelled by the North Vancouver Ferry. The service level became less continuous, and evening operation ceased in 1957.⁷⁶ The West Vancouver ferry changed its headway from twenty minutes to thirty minutes in April 1939. In July of the same year, Council adopted a policy to substitute lower cost bus service for the ferry during the "slack" periods of ferry use. By October, off-peak hourly operation alternated between the ferry and direct bus service to Vancouver. Various combinations of Vancouver bound ferry and bus service ensued until in September 1945, when evening ferry service had been curtailed completely.⁷⁷ Similarly, the level of service on the New Orleans ferry routes was allowed to vary with the demand for crossings.⁷⁸

Statistical comparison of ridership levels points out the third factor of the diminishing role ferries play in over-the-water transit when compared to urban bus systems. In 1945, the North Vancouver buses carried 200,000 passengers compared to 6 million on the ferry. By 1949, the bus routes carried 5.4 million passengers and the ferry only carried 2 million⁷⁹ -- a 72 percentage point decrease in the ferry's portion of cross Inlet transit. In 1953, the ferry only carried 25% of the morning peak two hour direction traffic volume and just 35% of the traffic in the evening peak across the Inlet.⁸⁰ A similar diminishing role occurred in such areas as New York, Boston and San Francisco as well.

The fourth factor that surfaced, dealt with the expansion of bus operation into new areas. Direct service, for instance, between North Vancouver and Vancouver by way of the Lions' Gate Bridge, was initiated by B.C. Electric on November 17, 1946. Since the route became operational, "the riding has been increasing on this route, and has been cutting into the North Vancouver revenue [ridership] very seriously."⁸¹ This route was accompanied by four additional new routes between 1946 and 1948.⁸²

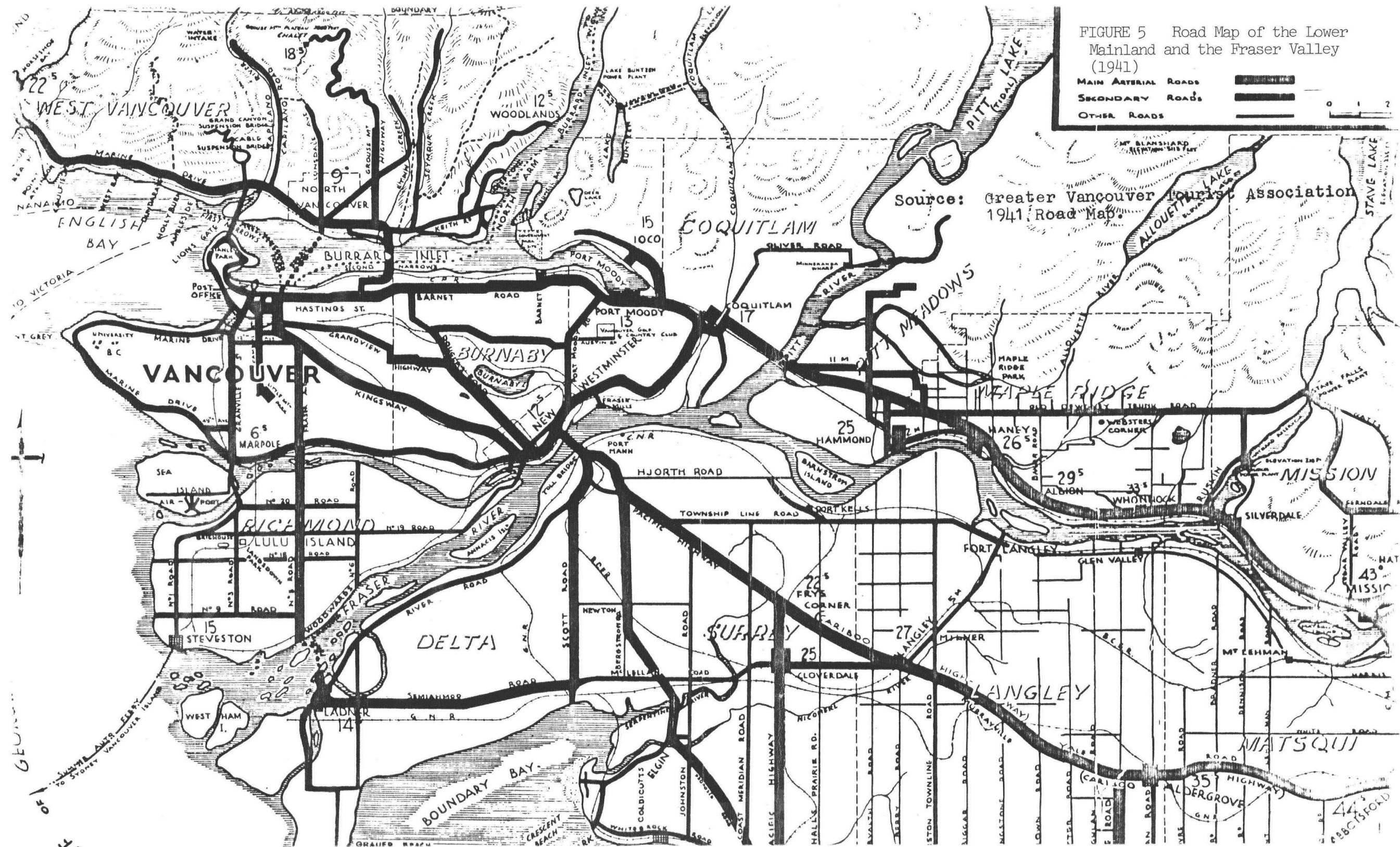
The fifth aspect concerned the increased numbers of unfilled route franchises. Upon withdrawal of the West Vancouver Ferry service in 1946,⁸³ the route was never again operational. When North Vancouver Council terminated the ferry run, operating rights were returned to the Provincial government, and the route remained idle. Similarly, following the abandonment of the Sausalito route in 1949, no operators tried to apply to the California State Railroad Commission to continue the operating rights.⁸⁴

The sixth aspect of route decline was a shift in the main ferry trip purpose, from the journey-to-work to recreational and pleasure travel. For example the final two years in the operation of the "Key System" between San Francisco and Oakland, saw service to the Golden Gate Inter-

national Exposition in 1940.⁸⁵ In 1935, the ferry "Sandy Hook" augmented its day time commuter service between Manhattan and the Atlantic Highlands with luncheon excursions and evening cruises.⁸⁶

Finally, the official road system gradually became designated to lead directly to bridges and to avoid ferry terminals. Urban arterials were upgraded in accordance to the comprehensive highway and road network plans, that were based on facilitating movements to and from major bridge corridors. According to an early Greater Vancouver Tourist Association map, (see figure 5) the Second Narrows Bridge appears as the primary over the-water link to the North Shore. The Lion's Gate Bridge, primary for the British Properties is but secondary in the road system. The ferry and its access streets are just on "other road". In San Francisco, some ferry operators attempted to correct this matter through road-side advertisting.⁸⁷

The final demise -- service termination -- generally came about in one of three ways. In the first instance, ferry operators were forced to terminate service by a statutory regulation. For example, section 7.09 of the San Diego Toll Bridge Resolution of 1966, covenants that no other competing facilities, including bus, rail, bridge or ferry, operate within ten miles from either side of the new bridge. This was an effort to assure the best circumstances for the sales of the toll bridge's bonds.⁸⁸ In New York, some service was outright prohibited by legislation favouring a commuter rail system shortly following the World War Two.⁸⁹ The second and most frequent form of service termination took place by the surrender of operating rights to the ferry regulating agency. This occurred in North Vancouver on August 30, 1958, when City Council relinquished to the Provincial government its operating licence.⁹⁰ Each of the first two instances, however, reflected a government policy that favoured



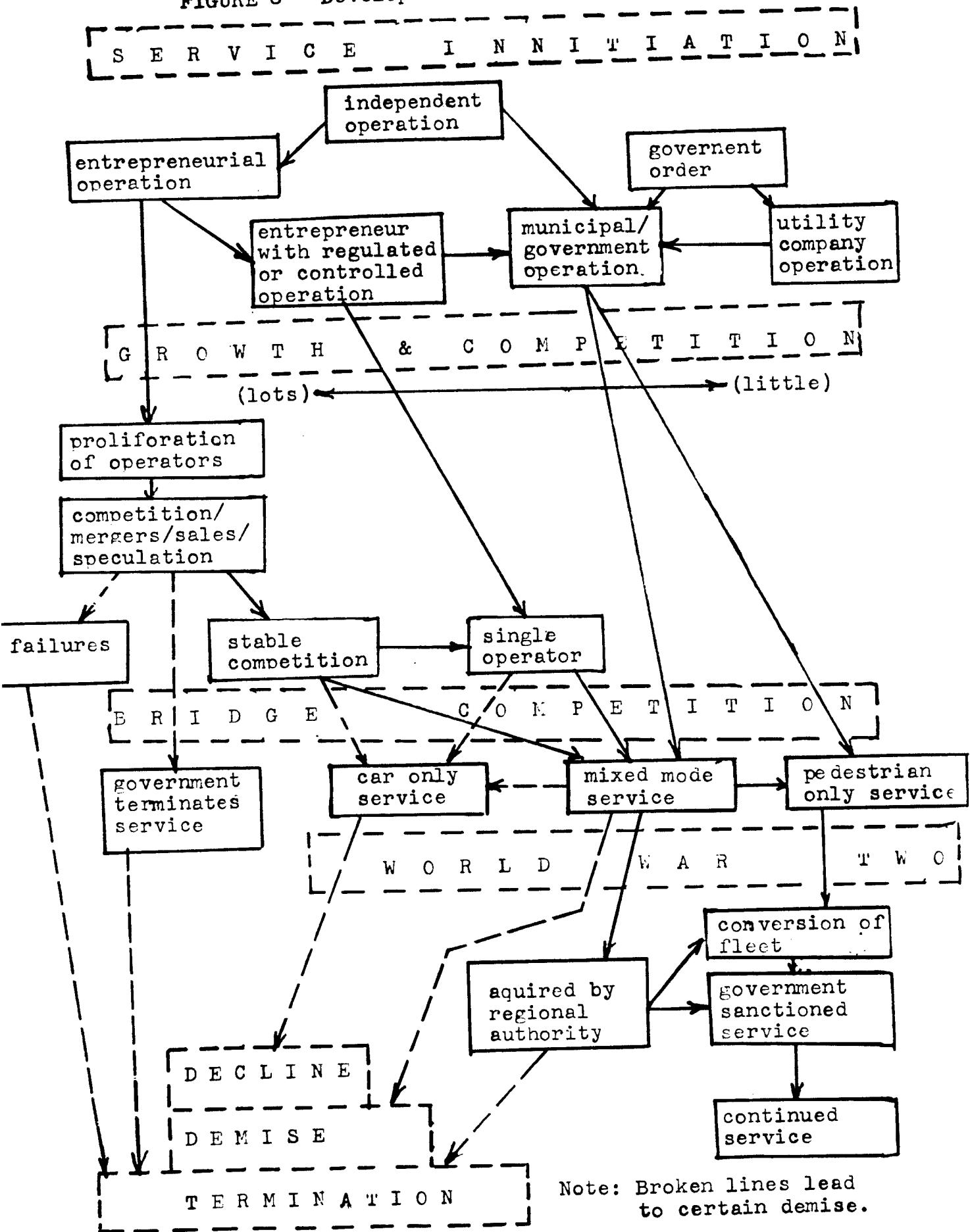
alternate transportation systems over the ferry. The third form of service termination stands apart as a middle-of-road policy of support--the purchase and take-over of ferry routes. Such a conscious effort was taken by the City of New Orleans.⁹¹ Three of the six ferry routes left operating after the opening of the Greater New Orleans Bridge, were purchased by the Mississippi River Bridge Authority between 1960 and 1969, to augment passenger, transit and automobile capacity provided by the bridge.

Summary of Findings

The foregoing discussion of historical trends in the development of the ferry industry, yields three notable findings. First, the ferry industry followed the traditional transportation life cycle of innovation, pioneering, rapid growth, competitive stability, a decline and a partial substitution by new technology. Secondly, those ferry systems that were not totally replaced by road, highway and bridge building technology followed a particular path of evolution. As depicted in figure 6, the only ferry systems succeeding were those (a) initiated by government or entrepreneurs; (b) converted to passenger only operation upon the start of bridge competition; (c) operated and improved during World War Two; (d) acquired by Municipal Government and; (e) sanctioned by higher levels of Government. Systems that followed the broken lines, failed.

Finally and most importantly, the analysis of the historical development of the ferry industry strongly suggested five areas of policy for increasing ferry patronage. These policies are related to (1) system access, (2) system orientation, (3) mode transfer, (4) system quality and, (5) positive public and political attitudes. In the first instance, ridership levels were determined by the adequacy of public transit provided to the ferry terminal. More specifically, the service had to be integrated

FIGURE 6 Development of Ferry Transportation



in one or more of the following ways: First a feeder system has to have a schedule and fare policy coordinated with the ferry system. Second, effective and convenient means of embarkation between the terminal and public feeder system has to be designed. And third, an effective interfacing of capacity between the feeder and ferry system was required to assure favourable passenger loads for each sailing, with no inconvenience to the user.

A second significant group of policies were based upon system orientation. Ridership could be increased by selecting the largest market having a predictable and repetitive travel demand pattern. It is therefore necessary to be responsive to the spatial and temporal characteristics (i.e. peak hour, peak direction, peak corridor and peak location) of the particular demand group. An optimally located ferry terminal in the market area, would seek to maximize access convenience and be served effectively by a simple feeder/distributor system. For the downtown terminal it is crucial that it be located in the proximity of the majority of destinations demanded by the user market. Stated in another way, the ferry must go to the locations that are demanded, and the system must travel in the direction that corresponds to this demand.

The concern of the next two policy areas is with the ability of physical features -- terminal functions and ferry vessels -- to attract more riders to the ferry system. The single most important policy requirement associated with the terminal facilities is the ability to make the mode transfer process as easy as possible. Terminals were built to load and unload cars -- not foot passengers. Walk-in and transit transferring patrons often had to wait on open, unsheltered docks, dodging cars and trucks that were getting on or getting off the ferry. A set of closely associated items relate to system quality. The policy of using a vessel

technology capable of bus-on-water type operation will provide the operator with a high capacity, modern and attractive vehicle that will draw ridership and provide a smooth, dependable, safe, reliable and quick service.

Finally, it cannot be too strongly stressed that no planning or policy device to increase ridership can succeed without a positive socio-economic attitude. Government support at least on the local if not provincial or national level is imperative for even a marginally successful ferry operation. Policies to increase ferry patronage require the catalyst of both political support in terms of legislation, regulation and financial assistance, and public support toward the use or community need for a ferry system.

FOOTNOTES

¹ Stanley M. Kowleski, "The Golden Gate Ferry System," in Second International Waterborne Transportation Conference Proceedings, ed. American Society of Civil Engineers (New York: American Society of Civil Engineers, 1969), p. 124.

² Kowleski, *Ibid*

³ Martha Reardon, "Commuter Boats in Boston Harbor," in Second International Waterborne Transportation Conference Proceedings, ed. American Society of Civil Engineers (New York: American Society of Civil Engineers, 1969), p. 71.

⁴ Rev. William D. Love, The Colonial History of Hartford (Hartford: By the author, 1914), p. 19.

⁵ Marcus Van Steel, "The Dartmouth Ferries Fight for Their Lives...," in The Atlantic Advocate 3 (November, 1956): 68.

⁶ George W. Hilton, The Staten Island Ferry (Berkeley: Howell-North Books, 1964), P. 19.

⁷ Love, *op. cit.*, p. 174-176.

⁸ Hilton, *op. cit.*, p. 24.

⁹ Personal correspondence with Mrs. J.M. Payzant, February 18, 1979.

¹⁰ Gene P. Rexrode, "Passenger Ferry Terminals on San Francisco Bay," in Second International Waterborne Transportation Conference Proceedings, ed. American Society of Civil Engineers (New York: American Society of Civil Engineers, 1969), p. 674.

¹¹ Kathleen M. Woodward-Reynolds, "The History of the City and District of North Vancouver," (*Masters Thesis*, University of British Columbia, 1943), p. 92.

¹² Captain James Barr, Ferry Across the Harbour (Vancouver: Mitchell Press, 1969), pp. 1-2.

¹³ Fredrick Jenkins Patterson, "A Financial History of the Corporation of the District of West Vancouver" (*Masters Thesis*, University of British Columbia, 1928), pp. 32-34.

¹⁴ Powers to issue ferry licences, regulate and establish ferries are found in the following sources: Canada, British Columbia Provincial Legislature, Vancouver City Charter, Chapter 34, Section 147 (72), 1886 Statutes of British Columbia; Canada, British Columbia Provincial Legislature, West Vancouver Charter, Chapter 60, Section 32, 1912 Statutes of British Columbia; Canada, British Columbia Provincial Legislature, Municipal Clauses Act, Chapter 32, Sections 295-301; Canada, British Columbia Provincial Legislature, Ferry Act, First Parliament, Third Session, Chapter 14, 1874 Statutes of British Columbia; and Canada, British Columbia Provincial Legislature, Ferries in Municipalities Amendment Act, Chapter 11, 1885 Statutes of British Columbia.

¹⁵ George H. Harlan, San Francisco Bay Ferryboats (Berkeley: Howell-North Books, 1967), p. 13.

¹⁶ Harland Bartholemew and Associates, A Preliminary Report Upon the Major Street Plan and Transit Facilities, prepared for the West Vancouver Planning Commission (West Vancouver, B.C.: District of West Vancouver, 1946), p. 14.

¹⁷ Personal conversation with Mr. Med Chapman, Transit Manager of West Vancouver Municipal Transportation on January 17, 1979.

¹⁸ Harlan, op. cit., pp. 15, 107-108.

¹⁹ Personal conversation with Mr. Charles Spratt, Sea-Bus Manager, on January 5, 1979.

²⁰ Urban Transportation and Planning Associates, Inc., Park-and-Ride, Park-and-Paddle Feasibility Study, prepared for the City of New Orleans (New Orleans: City of New Orleans, 1973), p. 4.

²¹ Barr, op. cit., p. 2.

²² [San Diego and Coronado Ferry Company], Pathways Through the Bay ([San Diego] : [San Diego and Coronado Ferry Company], [1969]), p. 3.

²³ Woodward-Reynolds, op. cit., p. 93.

²⁴ Burnes, op. cit., p. 25.

²⁵ Barr, op. cit., p. 2.

²⁶ Patterson, op. cit., p. 34.

²⁷ Phyllis Sarah Walden, "A History of West Vancouver" (Masters Thesis, University of British Columbia, 1947), p. 61, 62.

²⁸ Reardon, op. cit., p. 72.

²⁹ R.J. Colleran and W.J. Funge, "The Forgotten Resource: Waterborne Transportation," in Second International Waterborne Transportation Conference Proceedings, ed. American Society of Civil Engineers (New York: American Society of Civil Engineers, 1969), p. 35.

³⁰ Harlan, op. cit., p. 21.

³¹ John R. Burnes, Echoes of the North Vancouver Ferries (Vancouver, B.C.: By the Author, 1975), pp. 66-67.

³² Harlan, op. cit., pp. 131-134.

³³ [San Diego and Coronado Ferry Company], op. cit., p. 4.

³⁴ Personal correspondence with Mrs. Payzant, February 18, 1979.

³⁵ Woodward-Reynolds, op. cit., p. 93.

³⁶ John R. Burnes, North Vancouver 1891 - 1907 (North Vancouver, B.C.: By the Author, 1972), p. 25.

³⁷ Woodward-Reynolds, op. cit., pp. 96 - 98.

³⁸ Barr, op. cit., pp. 2 - 3.

³⁹ Woodward-Reynolds, op. cit., pp. 96 - 98.

⁴⁰ Bartholemew, op. cit., p. 14.

⁴¹ Patterson, op. cit., p. 34.

⁴² Barr, op. cit., p. 1.

⁴³ Barr, op. cit., p. 9.

⁴⁴ Personal conversation with Mr. Ned Chapman on January 17, 1979.

⁴⁵ Reardon, op. cit., pp. 71 - 73.

⁴⁶ Harlan, op. cit., pp. 115 - 120.

⁴⁷ Letter from Mrs. Payzant, February 18, 1979.

⁴⁸ Patricia Roy, "The British Columbia Electric Rail Company, 1897 - 1928" (Ph.D. Thesis, University of British Columbia, 1970), p. 92.

⁴⁹ Walden, op. cit., pp. 61 - 62.

⁵⁰ Harlan, op. cit., p. 131.

⁵¹ Harlan, ibid., pp. 131 - 133.

⁵² Harlan, ibid., p. 147.

⁵³ Bartholemew, op. cit., p. 147.

⁵⁴ [San Diego and Coronado Ferry Company], op. cit., pp. 5, 8.

⁵⁵ Harlan, op. cit., p. 135.

⁵⁶ Dartmouth-Halifax Bridge Commission, First Annual Report (Halifax: Dartmouth-Halifax Bridge Commission, 1951), p. 2.

⁵⁷ Letter from Mr. Harold K. Katner, Director-Secretary, City of New Orleans Planning Commission, November 7, 1978.

⁵⁸ Golden Gate Bridge, Highway and Transportation District, Five Year Development Plan (Draft) (San Francisco: Golden Gate Bridge, Highway and Transportation District, 1979), p. 3.

⁵⁹ URS/Cloverdale and Colpitts, Inc., Linscott Associates, San Diego Passenger Ferry Feasibility Study, prepared for the Comprehensive Planning Organization on the San Diego Region (San Diego: Comprehensive Planning Organization on the San Diego Region, 1975), p. 4.

⁶⁰ Rosemary Eng, "West Van," Vancouver, October 1978, p. 34.

⁶¹ Barr, op. cit., p. 68.

⁶² Harlan, op. cit., p. 147.

⁶³ Harlan, ibid., p. 19.

⁶⁴ Arthur D. Little, Inc., Feasibility Study of San Francisco-Marin Ferry System (San Francisco: Arthur D. Little, Inc., 1969), pp. 6 - 8.

⁶⁵ Russel Chappell, "How to Stretch a Nickel for 5 1/2 Miles," New York Sunday Magazine, May 26, 1974, p. 15.

⁶⁶ Van Steel, op. cit., p. 65.

⁶⁷ Little, op. cit., p. 7.

⁶⁸ Van Steel, op. cit., p. 66.

⁶⁹ Development Planning Association Limited, Dartmouth-Halifax Ferry Study, a report prepared for the City of Dartmouth (Dartmouth, N.S.: City of Dartmouth, 1976), p. S-1.

⁷⁰ Van Steel, op. cit., p. 65.

⁷¹ Barr, op. cit., pp. 62 - 64.

⁷² Barr, ibid., p. 66.

⁷³ Van Steel, op. cit., p. 65.

⁷⁴ Bartholemew, op. cit., p. 17.

⁷⁵ A Report on the Burrard Inlet Crossing, by P. D. Willoughby, Chairman (Vancouver, B.C.: Committee on Burrard Inlet Crossing, 1954), p. 7.

⁷⁶ Personal conversation with Mr. W. Baker, North Vancouver City Archivist, on January 17, 1979.

⁷⁷ West Vancouver Library, Ferry Newsclipping Archives file from the Vancouver Daily Province.

⁷⁸ Letter from H. K. Katner, op. cit.

⁷⁹ British Columbia Electric Railroad Company, "Mainland Transit (excluding Inter-urban Rail Lines) Statistical Comparison of years 1945 (before Conversion and Modernization commenced) with 1949 Internal Memorandum," Vancouver Transportation Engineering Department, March 15, 1950.

⁸⁰ A Report on Burrard Inlet Crossing, op. cit., pp. 6, 7, 9.

⁸¹ R. H. Martin, An Outline of Some of the Principle Events and Developments in the British Columbia Electric Transit System on the Lower Mainland in the Post-War Period (Vancouver: British Columbia Electric Railroad Company, [1950]), p. 11.

⁸²British Columbia Railroad Company, "Route Changes, Mainland Operations, by Years, 1946 to 1949 Inclusive. Internal Memorandum," Vancouver, B.C.: Transportation Engineering Department, March 15, 1950.

⁸³Personal conversation with Mr. Lou Gibons, Assistant Operating Manager of the West Vancouver Municipal Transportation System, on January 2, 1979.

⁸⁴A. D. Little, Inc., op. cit., p. 7.

⁸⁵Harlan, op. cit., p. 23.

⁸⁶Colleran and Funge, op. cit., p. 35.

⁸⁷Harlan, op. cit., p. 151.

⁸⁸URS/Colpits and Linscott Associates, op. cit., p. 6.

⁸⁹Colleran and Funge, op. cit., p. 35.

⁹⁰Barr, op. cit., p. 67.

⁹¹Urban Transportation and Planning Associates, Inc., op. cit., p. 5.

CHAPTER THREE THE PLANNING MILIEU AND FERRY REVITALIZATIONIntroduction: The Planning Milieu

The emergence of transportation planning as a profession distinct from engineering and design occurred over a number of steps over the two decades following World War Two. The end of hostilities brought a diversion of capital for upgrading, improving and replacing neglected urban services and utilities. Transportation planners entered into the forefront of land-use and transportation modelling, to predict future transportation needs. This work was translated into large scale national highway projects -- the Inter-state Highway System in the United States and the Trans-Canada Highway across Canada. These projects emphasized inter-urban expressways that criss-crossed major metropolitan areas. In the 1960's, however, transportation planning began to question these highway solutions on both social and environmental grounds. Functionally, highways became unable to cope with rapid demand for more mobility by the urban commuter. In British Columbia, car ownership skyrocketed from about 200 thousand in 1950 to 550 thousand in 1960, then doubling again in the early 1970's. The bulk of this provincial growth occurred in the Greater Vancouver Regional District.¹

Increased car ownership combined with population growth had directly resulted in rising congestion on all urban arterials, highways and bridges. Especially during the peak-hour periods, major capacity deficiencies became evident at critical links in metropolitan road networks. There were long delays at bridges, and line-ups as traffic queued its way on to and over these structures. In Vancouver, the ability of the Lions' Gate Bridge to provide the demanded capacity has brought about the prolongation of the period at which the bridge functions at its presently designed two lane,

one way capacity of 3,500 vehicles per hour (VPH), the so-called "peak-loading." As demand grows, the fixed bridge capacity caused a broadening of the peak-loading period, in the peak traffic direction. Figure 1 illustrates this effect, and how it has increased in magnitude over the eight years between 1965 and 1973. Referring directly to figure 1, the solid curves represent the idealized North Shore commuter demand to cross the Lions' Gate Bridge during the morning rush to the downtown peninsula. The demand is represented in units of flow -- vehicles per hour. But the bridge has a fixed physical capacity, and can only accommodate the flow up to the horizontal dotted line. As a result, the demand that exceeds bridge capacity (the area of the curve above the dotted line and below the demand line), must be distributed over the time when the bridge has reserve capacity (the area below the horizontal line and above the demand curve when the demand is less than the loading capacity). In 1965, the period of time between 8:00 a.m. and 8:45 a.m. was required to dissipate excess demand, and the bridge operated at peak-loading between roughly 7:15 and 8:45 -- a total of 105 minutes. Applying the same analysis to the 1973 idealized demand curve, the peak loading period has grown to 165 minutes -- a broadening of both the start and end of the peak-loading period by thirty minutes each. Presently, the Lions' Gate Bridge is operating at peak-loading in the direction of the downtown for practically the entire morning between 6:00 a.m. and noon. The same capacity problem has been experienced on the Golden Gate Bridge where traffic flows have increased ten fold in its four decades of operation.² Travel delays, in terms of average queuing time for a vehicle is ten to fifteen minutes onto the Lions' Gate Bridge, and twenty to thirty minutes for the Golden Gate Bridge.³

The early statements and claims about bridges were in stark contrast

FIGURE 1 1965 - 1973 Peak Period Demand Across
Lions' Gate Bridge -- One Way

See: S. Mullerheim and E. Laks, Feasibility Study of Ferry
Mass Transit Across Burrard Inlet (Vancouver, B.C.:
By the Authors, 1972), figure 2.

to the real world situation of the 1960's and 1970's. For example, in 1942 Banks predicted that only a two lane bridge at the First Narrows was necessary to accommodate the maximum hourly predicted lane capacity of 1,900 vehicles.⁴ As can be seen in figure 1, the peak hourly capacity demand in 1973 was three times higher at 6,000 vehicles. Banks gave a "generous estimate" of the number of cars the bridge would serve annually as 16.5 million but the present annual total of vehicles using the Lions' Gate is in fact nearer to 20.0 million.⁵ In a statement made by Joseph B. Struss, chief project engineer of the Golden Gate Bridge:

The capacity of the Golden Gate Bridge is six to eight times greater than the maximum traffic over the heaviest trafficked toll bridge in the United States, i.e., the Delaware River Bridge...These figures dispose of the question of the adequacy of the Golden Gate Bridge for all the traffic the future can bring.⁶

The engineers grossly underestimated the travel trends of future North Americans.

The failure of bridges and the associated highways to meet their operating goals and functions, led to a second round of comprehensive bridge and freeway plans. They were exclusively tailored to add significant additional over-the-water transportation capacity for the foreseeable future. In Vancouver, consultants predicted that four additional lanes across the Burrard Inlet at the First Narrows would become necessary by 1976 and a total of 28 lanes by 2000.⁷ Analysts in San Francisco predicted that as many as twenty lanes across the Golden Gate to the city would be needed by 2020.⁸

Meanwhile, a new public mood prevailed -- one of greater awareness of local affairs and community issues. This was a North America wide phenomenon that encompassed Vancouver by the mid-1960's. By 1969, the principles of public participation in development decisions and local decisionmaking on

local issues became widely accepted. Citizens questioned the effects of urban renewal and road building on the environment, ecology and indirect effects upon people and society. The specific concerns included the adverse social and cultural impacts created by these large scale projects upon residents of inner-city neighbourhoods. Expressway construction was often associated with projects for the redevelopment of blighted inner urban core residential areas. By 1969, public opinion was opposed to demolition. In Vancouver, those grand scale urban renewal projects begun in 1966, in Strathcona, Kitsilano and the downtown were halted by the Federal government until a "more well defined and logical long-term Canadian urban renewal policy can be formulated".⁹ Vancouver citizens were instrumental in having renewal projects replaced in 1973 by smaller-scale local area planning programs such as NIP and RRAP. This was part of a new movement to preserve, re-habilitate and re-use old buildings. Rather than creating a new urban character, the city proceeded with "preserving heritage buildings, structures or land which collectively represents a cross-section of all periods and styles".¹⁰

The awakening of public awareness and participation was co-incident with developments on the political level. Changes to and restructuring of the municipal government in Vancouver had occurred. In a decision internal to City Hall and the Council, the Social Planning Department was formed in 1967.¹¹ In a decision external to the city, in 1971 the provincial government altered the Charter of Vancouver to allow for partisan politics on the municipal level. These two events, coupled with the prevailing public mood, became translated into grass-roots political action. The many stormy public meetings on bridges and freeways of the 1960's, finally led to the "Great Freeway Debate", of 1967. Council had given its approval for the construction of the Strathcona highway interchange. Many citizens believed

council had defied their wishes and "cast the die for a future highway system".¹²

The culmination of the "Great Freeway Debate" was described by Hardwick as:

...the public became alarmed. Two public meetings were held at which civic organization made briefs -- most objecting to the government process which would bring about decisions that would affect hundreds of citizens without any consultation. They reacted against economic-efficiency models and cost/benefit analysis, neither of which included any social or aesthetic benefits. They reacted against a government which did not see itself in a representation role, but a technostucture that dwelt in professional isolation. Council rescinded its motion. The interchange was abandoned and the whole public transportation system was placed in the public forum for discussion and review.¹³

Vancouver was not alone in its rejection of a freeway. A very near parallel existed in the San Francisco "Freeway Revolt" in 1959. Approval to six freeway routes was withdrawn by the Board of Supervisors due to public protest. The public cries were, "Don't destroy our beauty and heritage -- stop the freeway -- stop the garages -- bring back the ferryboat!!"¹⁴

With the rejection of freeways, the remaining years to the early 1970's were spent arguing public transportation. The public assumed that with the provision of no new freeways, no new traffic would be generated. The existing overflow could be accommodated by transit -- Bart in San Francisco, reorganized bus transit in Vancouver. However, the no-growth assumption proved to be a fallacy -- congestion rose despite termination of freeway and bridge projects.

In the period since freeway rejection, both these west coast cities again found themselves in the situation of re-adopting freeway projects. The public response, however, was again negative. Kowleski recalls, "In late 1970 and early 1971, the Golden Gate Bridge and Highway District held nearly 23 meetings....It was apparent...that the public was strongly opposed to construction of new bridges or tunnels".¹⁵ In 1972, Vancouver council again emerged with a policy to build a third Burrard Inlet crossing, and

associated access highways. Public furor was channeled into the election of two anti-freeway governments. Locally, the T.E.A.M. civic party gained control in Vancouver City Hall in December of 1972. And the N.D.P. was elected in October 1973 on the Provincial level.¹⁶ Not only were these governments anti-freeway but very much pro-transit. The events which led to the reinstitution of the North Vancouver to Vancouver ferry, in 1977, were described in a journal article as:

Following a stormy and continuing outcry against the building of a third bridge, local officials took another look at buses. It was evident that an alternative had to be found because of the delays being imposed on the buses by lengthening bridge queues.... The solution? development of Sea-Bus, a waterborne rapid transit system...¹⁷

The Planner's Response

With the second rejection of freeways and the continuation of traffic congestion, transportation planning entered into the forefront. The first response was to suggest policies leading to the higher utilization of available roads and bridges, with only selective road construction.¹⁸ Higher vehicle loading was encouraged through car-pooling and bus use. The benefits were marginal at best, for these vehicles often found themselves within the same urban road congestion as all other vehicles.

A spectrum of solutions became advocated by planners to overcome the congestion problems experienced by public transit. At one extreme, the solution entailed provision of exclusive right-of-ways for bus or rail transit. In the middle of the spectrum was the introduction of bus privileges, to provide some time advantage for transit at critical bottlenecks in the urban road network. These included queue jump lanes, signal pre-emption, curb and counterflow lanes, and use of selected streets as exclusive transit malls. The restriction or exclusion of automobile

use in some portions of the downtown was also advocated. At the other extreme, non-transportation solutions to traffic problems were forwarded. Some transportation planners advocated the staggering of work hours, a four day work week, living closer to work, decentralization of activities from the downtown to the suburbs, and the substitution of travel by communication. In Vancouver, items from across the spectrum were selected and implemented: the False Creek housing development, the Granville Transit Mall, queue jump lanes from Marine Drive on the North Shore onto the Lions' Gate Bridge, decentralization of some activities to suburban "Metrotowns", and voluntary adoption of the four day work week by some offices. However, continued traffic growth precluded any major success in congestion relief.

The second response of transportation planners envisioned the reinstitution of transit on traditional corridors using new technology. Planners recognized that movement on the urban scene continued to concentrate along former interurban, streetcar or ferry routes in the built up areas. Congestion occurred largely in these corridors at points constrained by bridges, geographic layout and/or terrain. The belief arose that augmenting capacity in these traditional travel corridors by reinstating technologically improved and functionally enhanced mass transit systems could relieve congestion at bottlenecks and on primary streets and highways. These links were envisioned as major line-haul routes, running through areas capable of supporting rapid transit, that could be easily augmented through bus feeders from new suburban areas. In this rationale, ferries were seen as a potential key over-the-water link in an integrated urban transit network. The revival of the ferry transit concept is a direct derivative of the revitalization, preservation, social and environmental sensitivity advocated by the anti-freeway forces.

The Ferry Advocates

Those who championed the revival of urban ferries -- planners, politicians, businessmen and citizens -- are referred to in this thesis as the 'ferry advocates'. These individuals had a rather consistent philosophy expressed through certain claims about the ferry boat alternative. Some of these claims were based on historical facts, some on rational planning analysis and some were just intuitive in reaction to freeway and bridge proposals. A number of these claims fell into the broad spectrum of physical features. First of all, the advocates contended ferries had the ability to provide the most direct routing between any two points, on opposite shores.¹⁹ Also, they called attention to the large uncongested expanse of water, that could be utilized as a "water highway" for ferries.²⁰ Colleran and Funge concluded, "...it would appear that more consideration should be given to better utilization of our natural highways -- the waterways -- for transportation of...passengers...."²¹

These physical factors also were linked to economic concerns. The advocates stated that ferries would be using public waterways, which do not require any expenditures to acquire for use as a right of way.²² Similarly, only a minimum amount of land in high value urban areas was needed, as opposed to a ground transit alternative. Finally, advocates claimed that the actual use of the right of way, would incur little or no cost to operate and maintain.²³ According to one consultant in the east, "...the time has arrived for metropolitan New York to take advantage of the free right-of-ways and our rivers and our bays...."²⁴

A number of claims featured both physical and operating matters. First, advocates reasoned that public water-ways can provide vast potential capacity, limited only by vehicle size, optimal speed, the number of terminals and the boarding/disembarking times of users. Secondly, they generalized that the

ferry is a better, unique, interesting and practical form of rapid transit for metropolitan areas situated upon natural bodies of water.²⁵ Third, because the ferry was considered by the public as an innovative transit concept, its implementation would attract greater numbers of choice riders than any other form of exclusive over-the-water public transit.²⁶ Finally, the level of comfort and ride quality made the ferry more suitable than the conventional commuter bus.²⁷

Beside the category of physical features, both operating and economic considerations had been stressed as a distinct and important positive claim. Perhaps the most vocally argued claim was that pedestrian ferries would reduce peak hour bridge, tunnel and downtown street traffic congestion. As one of the reasons for re-introducing the North Vancouver ferry, Mullerheim and Laks indicated that a ferry system, integrated with transit, and with a well designed terminal and convenient parking would be "capable of drawing enough patrons to effect a sizeable reduction in peak hour traffic over the Lions' Gate Bridge."²⁸ Only second to this operating success claim, became the assumption that ferries are a "no lose" proposition. In reference to the San Francisco-Marin Ferry service, this claim was voiced as "...congestion on our highways will continue....There is little doubt that the ferry system... will shortly assume a greater role in contributing to the solution of the growing transportation problem...."²⁹ In reference to future patronage levels, the British Columbia Bureau of Transit Services assumed that all future growth in cross-inlet travel in excess of bridge capacity would be handled by transit -- namely Sea-Bus.³⁰ This "no lose" proposition, was also articulated in terms of economic considerations alone. Aside from the specifics which follow, advocates claimed ferries were the most economically feasible option in light of then existing societal values.³¹ In discussing transportation solutions, Kowleski referred to ferry operations, stating, "...this

basic mode of transportation has been utilized effectively by most ever... country in the world....The world wide interest in...waterborne crafts are varied but all have one thing in common -- it is cheaper than many of its alternatives."³² Indeed, advocates stressed that ferry systems would require lesser capital investment than bridge or bus systems, providing equal operational capacity. Secondly, unlike bridges, ferries were deemed to be a flexible investment because of the capability of being sold, replaced, structurally stretched to increase capacity or adapted for other marine uses. Third, as an indirect long term benefit, the reduction in automobile volumes would result in lower maintenance costs for urban arterial streets and bridges. Fourth, lower peak-hour traffic growth would postpone many secondary road and bridge projects necessitated by the pressures of congestion. Finally, advocates also claimed that operating costs for ferry systems would be lower per passenger than for other equivalent labour intensive alternatives.

Advocates pointed to a number of ancillary advantages flowing from the physical, operating and economic features. First as a direct result from reduced congestion, advocates claimed sizable reductions in travel time would be achieved by the average commuter.³³ Furthermore, travel costs and energy consumption for the commuter would decline modestly.³⁴ Another frequently cited claim envisioned a reduction in the demand for downtown parking, and potentially freeing-up land for other more beneficial purposes.³⁵ In terms of growth impacts, ferries would not generate the sudden increase in capacity as would new bridges and tunnels. Ferry capacity can be slowly increased, to reflect the desired land use policy.³⁶

Perhaps the third most frequently articulated claim stressed the conformity of ferry systems with community goals.³⁷ Ferry advocates attributed no negative social impacts due to construction or operation. Second, few ecological or environmental impacts were claimed to result from any land or

sea-side ferry facilities. Other positive ramifications cited include reductions in ambient noise levels, increased air quality along urban corridors and fewer motor vehicle accidents. Some advocates went as far as to say ferries are better for one's health, provide relaxation to or from work and reduce tension or anxiety. Perhaps a comment on their society, New York ferry advocates claim a reduction in the possibility of transit hijacking.

The Ferry Revival

The ferry advocates were successful in achieving a revival of urban passenger ferry use in the 1960's and 1970's. This historical period of ferry operation had two phases: popular revival -- service initiated by the ferry advocates, and the formal revival -- service initiated by government. The first phase lacked any policy significance because of the small scale, independent ventures. They were instrumental to the extent that they raised public awareness and verified the existence of a fairly sizable market of potential ferry patrons. The second phase is dynamic in the sense that it continues to evolve throughout North America. It also linked the ferry revival concepts with urban and public transit revitalization policies in major metropolitan areas.

The Popular Revival

There are a number of common aspects that stand out in the phase of advocate initiated ferry systems. The first common aspect was the popular support for ferry revitalization. In Boston, for example, 12,000 people out of the 150,000 person labour force in the south shore area responded to a 1973 survey by saying that they would use a ferry to commute to work if one was provided.³⁸ A survey conducted by the North Vancouver paper "The Citizen", also indicated strong public support for ferry transit.³⁹ The actual initia-

tion of a ferry service route followed one of two processes. First, interested individuals would approach civic or business organizations, which in turn chartered a ferry from scenic or recreational operators for the citizen groups. Perhaps the earliest of such arrangements occurred in San Francisco. In March 1962, a seventy member Belvedere-Tiburon Ferryboat Club was formed through the local Chamber of Commerce and Conservation League. They chartered a sight seeing vessel from the Showboat Transportation Company, and operated two runs, morning and evening, between Tiburon and San Francisco's Market Street ferry terminal.⁴⁰ On the Atlantic Seaboard, Boston commuters formed the "Bring Back the Boat Committee" in 1976, that contracted Boston Harbor Cruises to operate ferry service between Hingham and downtown Boston.⁴¹

In the second process, a number of ferry operators initiated ferry service, independently or with some public encouragement. Douglas M. Emery, president of Harbour Ferries (Ltd.) in Vancouver, inaugurated a morning, mid-afternoon and evening commuter ferry service to the North Shore on September 7, 1968.⁴² Also in Boston, a series of voluntary studies, conducted by local consultants, convinced the Bay State Steamship Company to independently approach the Massachusetts Port Authority and the South Shore Chamber of Commerce to initiate ferry operation. The service began in August, and ran through the fall.⁴³

Another common aspect was the semi-exclusive nature of ferry patronage. Both the Tiburon and South Shore ferries took on the characteristics of a "commuter-club". Many major Boston employers encouraged their employees to commute by ferry. One company even allowed workers to arrive late, on the last morning run.⁴⁴ In San Francisco, long time neighbours, car-poolers or group bus users, commuted as a club by ferry.⁴⁵

A third common aspect encompassed the many expressions of optimism, both of operators and users. The president of Harbour Ferries saw the North

Vancouver-Vancouver route as one of three potential cross-Inlet routes his company would develop by the mid 1970's. In his optimism for success, the company secured a franchise to operate cable-ferries,⁴⁶ and ordered hovercraft ferries to supplement cross-Inlet operation.⁴⁷ Furthermore, he claimed his ferry "would solve Vancouver's First Narrows crossing problem."⁴⁸ In Boston, the reinstitution of ferry service brought "great festivity"⁴⁹ to the users and the South Shore Community. The Tiburon Ferry grew in popularity, gaining about fifteen new members per week.⁵⁰

Initial optimism was eclipsed by two additional common aspects. First, the service that ferry operators provided was uncertain in three respects: permanency of operation, operating schedule and route terminus. With regards to permanency, Harbour Ferries established ferry service for a thirty day trial period, to test economic feasibility and level of ridership. According to a local editorial report, "Harbour Ferries' officials are not sure what they are getting into and intend to be completely flexible in their operation..."⁵¹ Furthermore, Douglas Emery stipulated that service improvements, A North Shore parking garage and new terminal facilities were also dependent on the success of the trial service.⁵² There was a great deal of uncertainty about the permanency of the Hingham-Boston route as well. The Bay State Steamship Company terminated its service in November, 1975. Shortly thereafter, the route was re-instituted for a three week period in December by the Massachusetts Bay Lines. It was in the summer of 1976 that Boston Harbor Cruises took over operations on the route. Service fluctuated until operations ceased in the early fall. Citizens, in the spring of 1977, convinced the Bay State Steamship Company to re-establish the ferry route. With legislative assistance, the route remained in operation.⁵³ With respect to schedule uncertainty, Harbour Ferries planned to provide peak hour service at 15 minute intervals, for a total of thirty-two daily crossings.⁵⁴ Upon

service initiation, however, the schedule was reduced to six sailings towards the end of the trial period.⁵⁶ In Boston, sea conditions and tidal variations often necessitated alternate routes to avoid shallow water. The scheduled crossing time therefore fluctuated between forty-three and fifty-five minutes.⁵⁷ Route terminus was the third source of service uncertainty for the user. In its first year of operation, Harbour Ferries considered a change from the Granville Street Pier D Terminus to Columbia Street in conjunction with its cable-ferry concept; in the last year of operation, (1971) a change to one of two other North Shore termini, MacKay Avenue or Bewicke Avenue were considered.⁵⁸

The second common aspect that eclipsed the initial ferry service optimism was the ambivalence of local civic government towards the ferry operator. In Vancouver, Harbour Ferries gained only marginal attention and support from the North Vancouver City Council. On August 19, 1968, the Council resolved to grant a licence for the Harbour Ferries commuter ferry shuttle. Shortly before service commenced, Harbour Ferries asked if the City could perform some road and dock repairs near the ferry slip. The Council rejected this, sanctioning only minor and routine maintenance. The only positive response from the City came on the issue of bus access. The Council "agreed in principle", to request B.C. Hydro to install "a bus stop of temporary nature" near to the ferry landing.⁵⁹ According to Harbour Ferries, in time North Vancouver developed a "non-attitude" towards the ferry service, brought on in part by Council's alternative development plans for the Lower Lonsdale and Esplanade area.

A third aspect that detracted from the advocates' optimism, was the reluctance of public transit to integrate with the private ferry ventures. In downtown Vancouver, inability to secure the routing of some B.C. Hydro service to the ferry landing forced Harbour Ferries to charter peak hour bus

service for their customers.⁶⁰ In Boston, the Massachusetts Bay Transportation Authority (MBTA), did not permit hovercraft-ferry service prior to 1973, claiming unfair competition with MBTA rail rapid transit would be created.⁶¹

Service related difficulties and labour disputes became the fourth aspect that eroded optimism. First, service problems rested with the inaccessibility of terminal locations. Transit patrons in Hingham faced a five minute walk, on an unpaved road from the nearest MBTA transit stop to the ferry.⁶² In North Vancouver, the closest bus stop to the ferry was at Chesterfield and Esplanade; while on the Vancouver side, riders had to climb some forty steps to cross over the Canadian Pacific railroad tracks.⁶³ Second, service problems arose out of docking arrangements. In Vancouver, the National Harbours Board refused to relax rules, and charged full rates for water lots.⁶⁴ In Boston, service problems were often experienced as a result of an inadequate number of ferryboats, slow sailing speed and under-water obstructions causing docking difficulties.⁶⁵ Thirdly, labour problems were encountered. For example, a strike in 1969 terminated the Tiburon ferry service.⁶⁶

The final aspect was the growth of interest by regional, provincial or state governments in acquiring or providing assistance to revitalized ferry operation. This is a phenomenon that developed very late in popular revival period. It occurred in 1969 in San Francisco, when the Golden Gate Bridge, Highway and Transportation District, operated the Tiburon line, for the duration of a labour strike.⁶⁷ In Vancouver, a preliminary in-house examination at the Bureau of Transit Services in 1973 concluded that a ferry as one "advanced transit" link was feasible.⁶⁸ In 1976, the Massachusetts Port Authority applied to Urban Mass Transportation Administration (UMTA) for funding of a hovercraft demonstrator project.⁶⁹ The forces of the ferry revival succeeded in convincing decision-makers that commuter ferries were a serious urban transit alternative.

The Formal Revival

This phase of the urban passenger ferry revival, includes two classes of operations. The first category includes those ferry systems that continue to operate in competition with bridges. In the late 1960's and early 1970's, these government systems sanctioned studies to investigate expansion and upgrading of services. A series of such reports were done for the City of New York Marine and Aviation Department,⁷⁰ for the Dartmouth Ferry Commission⁷¹ and for the City of New Orleans.⁷² Policies bases on or derived from these reports have resulted in various major improvements projects. The second class includes all those systems that were legislatively instituted by senior governments. The most prominent recent examples are Vancouver's Sea-Bus, and the Larkspur and Sausalito ferries in San Francisco. Authority for the planning, development and operation of the Sea-Bus system, basically rested in the provisions of three provincial acts: The Transit Service Act, The Provincial Rapid Transit Subsidy Act and The Provincial Transit Fund Act.⁷³ The original policy framework for the Burrard Inlet Sea-Bus was evolved by the Bureau of Transit Services between 1972 and 1974, and in tri-partite discussions among B.C. Hydro, the Greater Vancouver Regional District and the Provincial Transit Services Division (formerly the Bureau of Transit Services) in 1976.⁷⁴ In 1969, the Golden Gate Bridge, Highway and Transportation District, was given authorization by the California Legislature to "engage in any and all modes of transit."⁷⁵ Shortly thereafter, the San Francisco Board of Supervisors resolved, "... operation of a system of ferry-transportation between Marin County and San Francisco...is... the policy of the Board of Supervisors..."⁷⁶ By 1971, the U.S. Department of Transportation adopted a favourable policy toward urban passenger ferry transit. Thus, financial support through various provisions of the Urban Mass Transportation Administration Act, established a series of demonstration ferry projects that included San Francisco.⁷⁷

On the regional and local level, a number of steps were taken that involved policy decisions and operational ramifications. Because of the lack of North American data on new ferry operations, the first step involved the gathering of information and an assessment of operating impacts. Information was consolidated in one of three methods. The first, largely utilized in the United States was the demonstration trial approach. In the Manhattan area, for example, a hovercraft demonstration project was conducted in 1974, to assess economic feasibility of operation, technical aspects of performance, plus physical and environmental constraints of the three service corridors tested.⁷⁸ The second approach involved systems modeling. A 1969 consultant report for the Marin Water Transportation Study Committee, modeled costs, ridership and system quality for various ferry routes from the county to downtown San Francisco.⁷⁹ In 1976, the Dartmouth ferry was modeled to determine the effect of various policy parameters on the mode split, ridership and operating costs of contemplated improvements and extension of cross-harbour service.⁸⁰ The final approach involves in-house discussions among transit planners, from local, regional, provincial and private organizations. This was the basic form of information gathering adopted by the provincial authorities in the Vancouver area. In-house reports, consultant studies, and exchanges with regional and local committees evolved the information base for the policy framework decisions.⁸¹

The second step involved the specification of vehicle design corresponding to the formulated operating policy. Because of the lack in clarity of the state-of-the-art in the marine ferry industry, each of the new ferry systems obtained the delivery of differing types of vessel technology. In Vancouver, Case Existological Laboratories proposed the use of a catamaran vessel. Its technology and design met the policy requirements of:⁸²

- high manoeuverability

- capacity of 400
- quick loading, unloading and turnaround time
- easy docking capability that avoided turnaround in the vicinity of the landing terminal
- crossing time of 10 minutes
- safe and economic to operate

In San Francisco, ordinary displacement vessels were replaced in December, 1976 by 'jet-foil' technology. This reflected the need to provide a high quality, comfortable and quick system that could compete in terms of time and amenities with other commuting modes, particularly the private car. Another policy objective included the implementation of cost-effective transit, higher utilization of buses and the reduction of automobile traffic from the Golden Gate Bridge and Downtown San Francisco Streets.⁸³ The Manhattan system envisioned one of three types of technologies: conventional displacement hull,⁸⁴ Surface Effects Vehicles (Hovercrafts)⁸⁵ and passenger barge/tug vessels.⁸⁶ Each met the selection criteria of providing economic, environmentally safe, high speed and low per seat cost service. The barge/tug concept also met the policy requirement of providing flexible, multi-purpose service, that could achieve a higher level of peak and off-peak hour utilization. For instance, passenger barges could be towed in trains or singly for journey to work purposes, for recreation purposes in the summer and as a general tug in the busy ports of New York Harbour. Preliminary designs of the new Dartmouth ferries, proposed the use of a standard displacement vessel. The policy requirements surrounding the design of the Dartmouth ferry involve similar safety, manoeuverability, cost and capacity requirements as Sea-Bus, with the exceptions of more stringent climatic amenities and the absence of the "flow-through" loading/unloading principle.⁸⁷

The provision of new, modern, well planned and integrated loading and unloading terminals became a key step in the revival plans of both classes of government operated ferry systems. The policy of constructing an attractive and functional transfer terminal was based on the need to facilitate

quick inter-modal transfers, accessible from residential areas and location in the proximity of the majority of daily work trip destinations. In Vancouver, the Bureau of Transit strongly promoted the policy of developing Canadian Pacific Rail's Granville Station into a major waterfront interchange for light rail, ferry, commuter and urban bus transit. Its proximity to the Vancouver office core offered the interchange the role as the prime arrival and transfer point for all downtown destinations.⁸⁸ The Market Street Ferry Terminal in San Francisco was also planned as a major downtown transfer point for BART, Muni, ferry and bus commuters.⁸⁹ Suburban terminals in Vancouver, Manhattan, San Francisco and New Orleans were intended to be designed as integrated facilities for both transit and automobile commuters. The Vancouver residential terminal does not yet have any automobile or taxi drop off facilities. In the desire to attract and further increase ferry ridership, three policies relating to use of suburban station design were contemplated and/or promoted. First, as a result of an overall policy framework to integrate ferry operations with regional transit, bus routes were restructured as ferry terminal feeders. This policy diverted only those bus routes where the bus and ferry trip combination saved time over existing bus on bridge routes. The second policy involved the force feeding of bus routes to ferry terminals. A trade-off level was therefore adopted between the desired level of ferry ridership and loss of local ridership as a result of longer trip times. The third policy encouraged the diversion of choice, non-transit commuters to public transit. The ferry terminal facilities incorporated within their design the kiss-and-ride and park-and-ride options. The average commuter thus has a choice between transit and non-transit means of ferry terminal access.

Finally, the last set of steps involve the ongoing implementation of amenity services, schedule policies and capacity requirements. These pol-

icies vary, depending on the level of convenience and comfort, the route distance and the crossing time. Amenities vary from hardly any on short distance and time routes such as Sea-Bus, to limited food and bar facilities on longer distance ferries such as Larkspur, and to full services on long commuter passenger routes such as the proposed Manhattan to Highlands New Jersey route. Scheduling, capacity and other service policies parallel similar steps followed by the general transit industry.

Summary

The transportation dilemma of the 1960's and 1970's brought about a change in the concepts and plans for urban transportation solutions. Congestion and the current ramifications of past failures to effectively assess the degree of urban infrastructure required to facilitate automobile movements engendered a change in the transportation planning milieu. The rejection of urban redevelopment, growth in the desire to preserve and revitalize the downtown, heightened grass-route political involvement and the environmental/ecological movement merged into the mainstream of transportation planning thought, bringing about the revival of ferry transit. Emphasis focused on person movements rather than vehicular movements in facilitating commuter access to downtown areas. As such, regional and provincial officials viewed ferry transit as a vital link within an upgraded and integrated multi-modal transit network.

The ferry advocates played an important role in the revitalization of ferry operations. Not only did they encourage the direction of urban transportation thought and raise public awareness about the ferry concept, but they clearly identified a set of characteristics associated with ferry operation. The optimism they generated was enough to overcome general scepticism and to establish a series of popular revival operations. The

claims that were proved to be true by these operations, put legitimacy behind the ferry alternative. Above all, it attracted the first serious support of government since the heyday of ferry operation.

The significance of the Formal Revival and positive government policies toward ferry transit have been and continue to be instrumental to revitalized ferry operation. Government has provided the resources and administrative backing that allowed for experimentation with new technologies and operating policies. For the first time, ferries fit into an overall policy of regional transportation and mass transit. Though the dominance ferries once had in over-the-water-transit will likely never be attained again, the adoption of a precise policy framework may enlarge and strengthen the role of commuter ferry transit on the urban scene.

Findings

The period of ferry revitalization yields five important findings. First, ferry transit was part of the larger urban planning movement that encouraged the restoration and preservation of downtown cores; and envisioned revitalization of traditional transit corridors to solve the urban transportation problem. Second, ferry advocates performed a significant task by enlightening and encouraging the public and planners about the potentials of revitalized ferry transit. Third, the participation of citizens in civic politics achieved a major redirection in transportation policy -- from highway and bridge building to public transit and ferry transit. Fourth, as a result of the policy change, transportation planning was able to become independent of the transportation engineering, to develop its own concepts and techniques and tackle the urban transportation problem.

Finally, a number of significant policies emerged with the potential of increasing ferry ridership. These policies can be grouped into four

categories: (1) Vessel-oriented; (2) Terminal-oriented; (3) Service Principles; and (4) Government support. In the first case, patronage levels can be increased through the effective technical and passenger accommodations design of the ferry vessel. Modern, fast, versatile and manoeuvrable crafts allow an operator to achieve higher over-the-water passenger capacity than with the vessels used previously. Similarly, properly designed passenger accommodations can attract users. These policies include providing on-board amenities, appealing boat decor and comfortable seating to convey a pleasing commuting atmosphere.

A second set of policies that can increase ferry ridership are related to the terminal and associated terminal facilities. It is important to implement policies that maximize a commuter's access choice. Access choice extends to mode types -- walking, transit and automobile -- and in the way the mode can be used. For instance, transit to the terminal could include local buses, fast buses, rapid rail and para-transit. For automobile patrons, an option ought to be provided between park-and-ride and kiss-and-ride. Associated facilities for each transit and automobile option must be integrated into one ferry terminal complex. Aside from choice, policies must also be adopted to avoid unnecessarily long walking distances, minimize passenger circulation impediments such as stairs, narrow passage ways, unlit or unsheltered areas. The waiting areas must include some level of amenities, comfort and general convenience.

The adoption of optimal service principles has the power to attract patrons. If a ferry system is to be part of an integrated transit network, it must be operated as a transit system -- this must be reflected in policy. Reliability, frequency, safety and dependability are basic criteria of such a policy. Furthermore, the ferry schedule requires coordination with public transit, and cater to public preferences for destination and arrival times.

Finally, the role of government in the ferry industry is again underlined. Active government support provides the basis and the resources to achieve the implementation of patronage increasing policies.

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CHAPTER FOUR POLICIES TO INCREASE FERRY PATRONAGEIntroduction: Policy Definition

For the purposes of this thesis, "policy" has been defined, following the Oxford Dictionary, as "a course of action adopted by government", either directly or indirectly. A policy framework will be taken to mean a set of policies that are complementary and intended to promote a specific type of outcome or response. The development of a policy framework requires a series of policies, which in turn are formulated through a policy-making process that selects or links together transportation planning techniques or devices. In themselves, these planning devices are but a set of generalizations and abstractions -- principles of transit operation, historic trends and service objectives. Policies propose a way to exploit these planning devices to achieve some policy ends. The policy ends that are the subject of this chapter are increased ferry patronage on existing routes and maximized patronage on new ferry routes. The magnitude of the intended increase in patronage is based on the goals and objectives adopted by government toward the ferry concept. It is also dependent upon the relationship to the larger goals and objectives of a transit system and of personal transportation. Whether these policies are components of the overall transit policy and specifically of over-the-water segments, would have significant bearing upon the potential role of a passenger ferry in an urban area.

Policies to Increase Ferry Ridership

A synthesis of findings about the history of the ferry industry, the claims by the ferry advocates and the events surrounding ferry revitalization were merged with the basic tenets of transit operation to develop a set of

policies capable of increasing ferry ridership. Not only does this section set down a number of courses of action, but specifies particular planning devices that can be used to achieve desired policy ends. In the wider sense, these planning devices are considered to be policies as well.

Three types of policy will be considered: Service policy (or operating factors) that deal with scheduling, frequency, etc.; Amenity policies (or amenity factors) that pertain to system attractiveness and convenience; and Indirect policies (access factors) that concern reaching the ferry system. These types of policy are applied to six broad components of the ferry transit concept: (1) User demand, (2) Operations, (3) Terminals, (4) Vessels, (5) Marketing and (6) Land Use policies. Emphasis is placed on the latter five.

User Demand

In specifying policies to increase ridership, it is necessary to identify a market to be addressed. Potential transit markets include commuter, shopper, recreational and leisure travellers. Because transit travel is predominantly work trips, user demand is discussed in terms of the commuter market group. This market may be subdivided into captive users and choice users. Those who are captive to transit are either too young or too old to drive, do not have a licence, or have no access to a car, and must rely on transit for their mobility. In the opposite respect, those not served or provided with reasonable access to transit are termed captive to car, because they must use their private automobile to commute. The third group of users fall in between, having a choice of taking a car or public transit to their work destination. These trip makers are called choice users. Therefore, the policies considered limit their focus to commuters who are or who can become choice users with the introduction of a suitable accessible transit link.

In dealing with policies oriented toward this user group, it is necessary to note the two directions from which policies can originate. First is the user demand side. There are particular periods of the day when the commuter wants service, provided at a certain level of quality, with preferred arrival times, for a set of specific destinations. Second, the demand side is mirrored by the supply side. The transit operator responds to the user demand through scheduling, route frequencies, times at which certain routes operate, number of vehicles, location of bus stops, routing and fares charged for the service. Though most policies to increase ridership attempt to manipulate the supply side of transit operation, it is useful to briefly discuss the mechanism of consumer choice, and therefore the nature of commuter demand to be accommodated by policy.

There are two approaches to understanding commuter demand; (1) the theory of commuter choice and (2) the concept of the value of time. The theory of commuter choice states that each travel consumer makes a choice between the cost he is willing to incur for a particular level of travel convenience.¹ For a single destination, such as the trip to work, the individual commuter will seek to optimize his travel path between the cheapest way, the fastest way and the most convenient way, where convenience is measured as a factor of time saved by one mode over another and the amenities encountered enroute. There is a level at which the commuter will derive greater benefit from amenities than from time savings in his total assessment of travel convenience. In addition, when all modes are considered, classical marginal analysis conveys the idea that the more one pays, the more utility one expects to receive out of the particular commodity consumed. But with each next increment consumed, the marginal gain to the consumer is less. Combining these three ideas, a continuum representing the trade-off between convenience and cost is obtained (see figure 1). This figure implies that

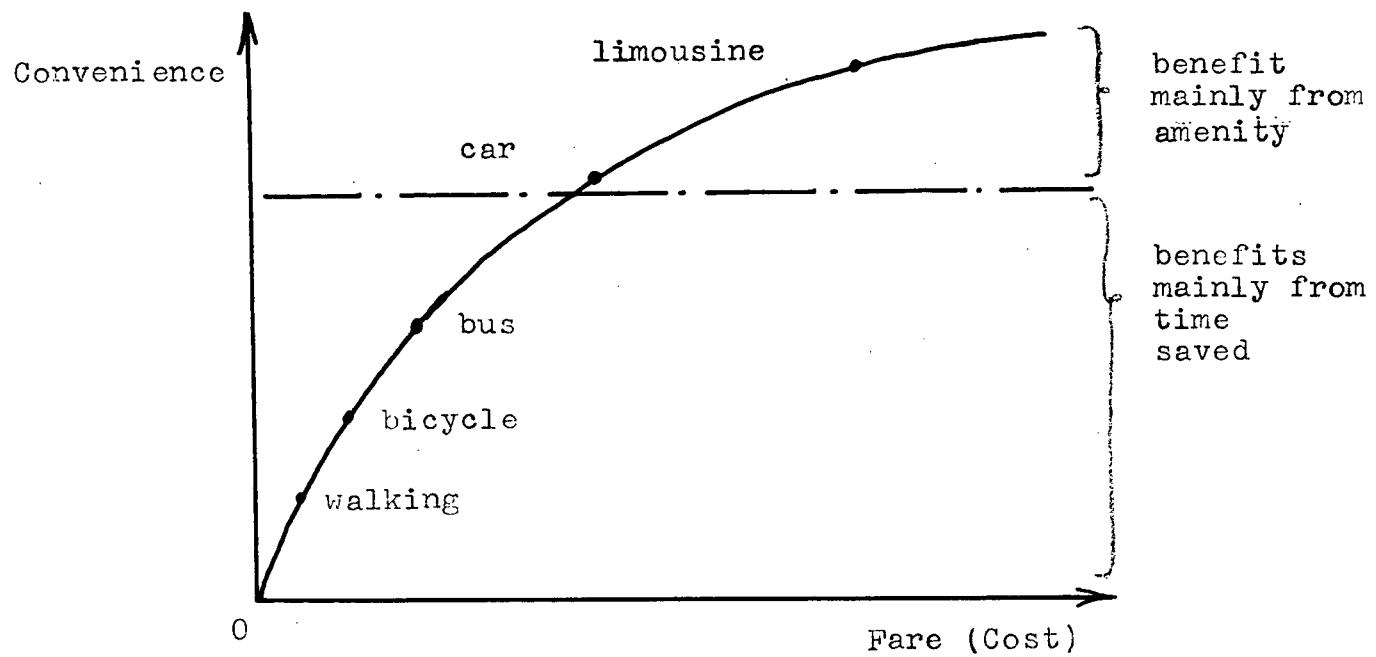


FIGURE 1 A consumer's trade-off between cost and convenience.

Adapted From: Roman Krzyczkowski, Over the Water Program Design Volume 3 (Springfield, Va.: National Technical Information Service, PB-216-068, 1971), p. 135.

when a commuter desires a higher level of convenience, he will choose the next higher mode of transportation, as he no longer derives as much benefit out of time savings alone. The figure also shows that lower modes cannot compete with higher modes on the basis of the relative travel times (i.e. net time savings) alone. As more people using public transit can afford a higher level of commuting convenience, they will shift to automobile use. It is therefore evident that one area of policy concern must be the provision of a higher level of convenience in a ferry system than the public presently expects from transit.

Another approach to user demand and modal choice is through the concept of the perceived value of time.² Different segments of travel are known to have different values, that can be expressed as weights by multiplying the actual time of each segment by a weighting coefficient. If time spent riding is given the value of unity, the relative weighting coefficients for walking to or from the origin or destination of a transit connection is two to three, for waiting at the bus stop for a transit vehicle is three to four, and for time spent in transferring between modes or routes is four to seven. The prevailing wage rate as an indicator of the average work commuter's value of time, can be used to transform the various segments of transit and private automobile access and travel times into dollar quantities that can be added to the other out-of-pocket expenses associated with the journey-to-work. This quantity is known as the generalized cost. The simple transformation to obtain a mode-specific generalized costs (g_{mode}) is:

$$g = (\sum_i b_i t_i) \text{ (wage rate)} + \text{out-of-pocket costs}$$

Where:

b_i = the weight coefficient associated with each access and travel segment as described above for transit trip segments

t_i = the actual time required for each segment

and i = an index of the different segments of a trip for a given mode.

If, $g_{transit} \leq g_{car}$ for a particular origin and destination, then a condition exists where the average commuter can make that trip by transit for less than the cost for him to drive his own car. In this situation choice users will tend to use the transit alternative.

For a range of generalized cost differences, a function is generated which predicts the percentage of transit users from the total number of commuters. In a hypothetical market portrayed by figure 2, the implementation of a policy reducing the generalized cost from a to b, would secure a 20 percentage point increase in the transit share of commuter trips. Therefore, the second requirement to be dealt with in achieving an increase in ferry patronage is to adopt policies that mitigate negative perceptions of ferry access, transfer and travel time, to bring the generalized cost to a level competitive with other modes.

From the mechanisms of user demand it is possible to determine the nature of three types of policies specified at the onset. First, service policies must act upon the perceived disparity between convenience levels of transit and car commuting. Second, indirect policies must reduce both the amount of access inconvenience, and the door-to-door commuting time for potential car/ferry or bus/ferry trip combinations. And thirdly, the direct implications of the two user demand theories, suggest a high level of emphasis be placed upon amenity policies. A recent report on the Golden Gate Ferry concluded:

It is a basic tenet in the transit industry that the speed of the vehicle, the frequency of service, the dependability of service, and the fare structure imposed upon the system, are principal factors which affect patronage. However, in today's transit market, another important key to public acceptability, whether it be a bus, train or ferry, is the amenity factor.³

Percent of
total travel
by transit

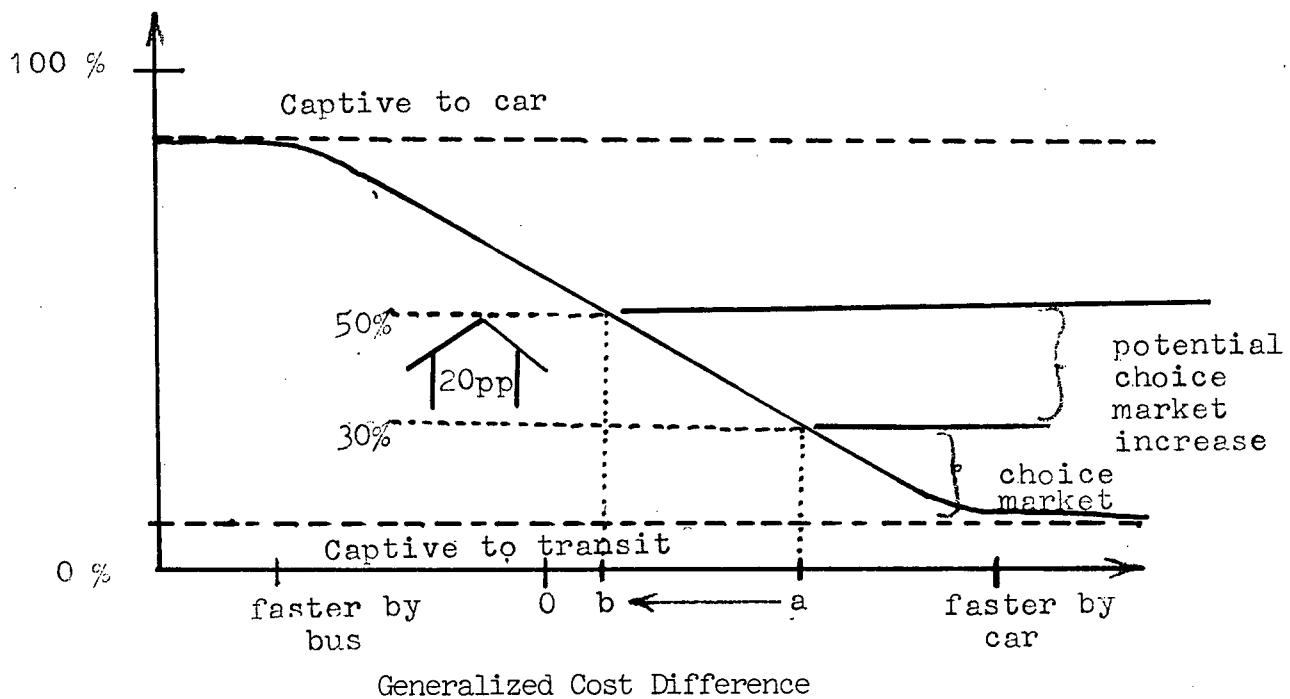


FIGURE 2. An example of increasing ridership through reduction in the perceived travel time on transit.

Adapted from: Transport Canada, The Fundamentals of Urban Transit (Unedited Working Paper) (Ottawa: Department of Supply and Services, 1978), 6-24.

Operation-Oriented Policies to Increase Ferry Patronage

The operational characteristics of a ferry transit system are the most important, most visible and often the aspects of service that primarily attract potential patrons. Therefore, adopting policies for the enhancement of selected ferry operation facets can have a formidable impact on increasing ridership. Operating policies define how the system is to function in order to balance demand and service goals with manpower and ferry equipment.

The following six policies appear to have a potentially substantial bearing upon ferry ridership:

(a) The policy on system orientation

System orientation is the degree to which the direction of the ferry service follows the desired commuter patterns.⁴ For a ferry system that primarily caters to journey-to-work trips, the degree to which the ferry concentrates upon the central business district will influence the level of ridership.

This policy can also be augmented by optimally oriented feeder corridors. Feeder routes that minimally retrogress from the desired travel orientation, will attract ridership. It is therefore necessary for the system orientation of the feeder network to follow that of the ferry system. An example of combined system orientation is illustrated in figure 3.

(b) The policy on destination proximity

The selection of a destination terminal requires maximizing the number of destination opportunities within a minimum walking distance (or walking time) from the downtown terminal. This is the basis of the policy of destination proximity. The locational decision is based upon trading off downtown locations -- office complexes, commercial stores, and institutional facilities -- with envisioned user profile. As shown in figure 4,

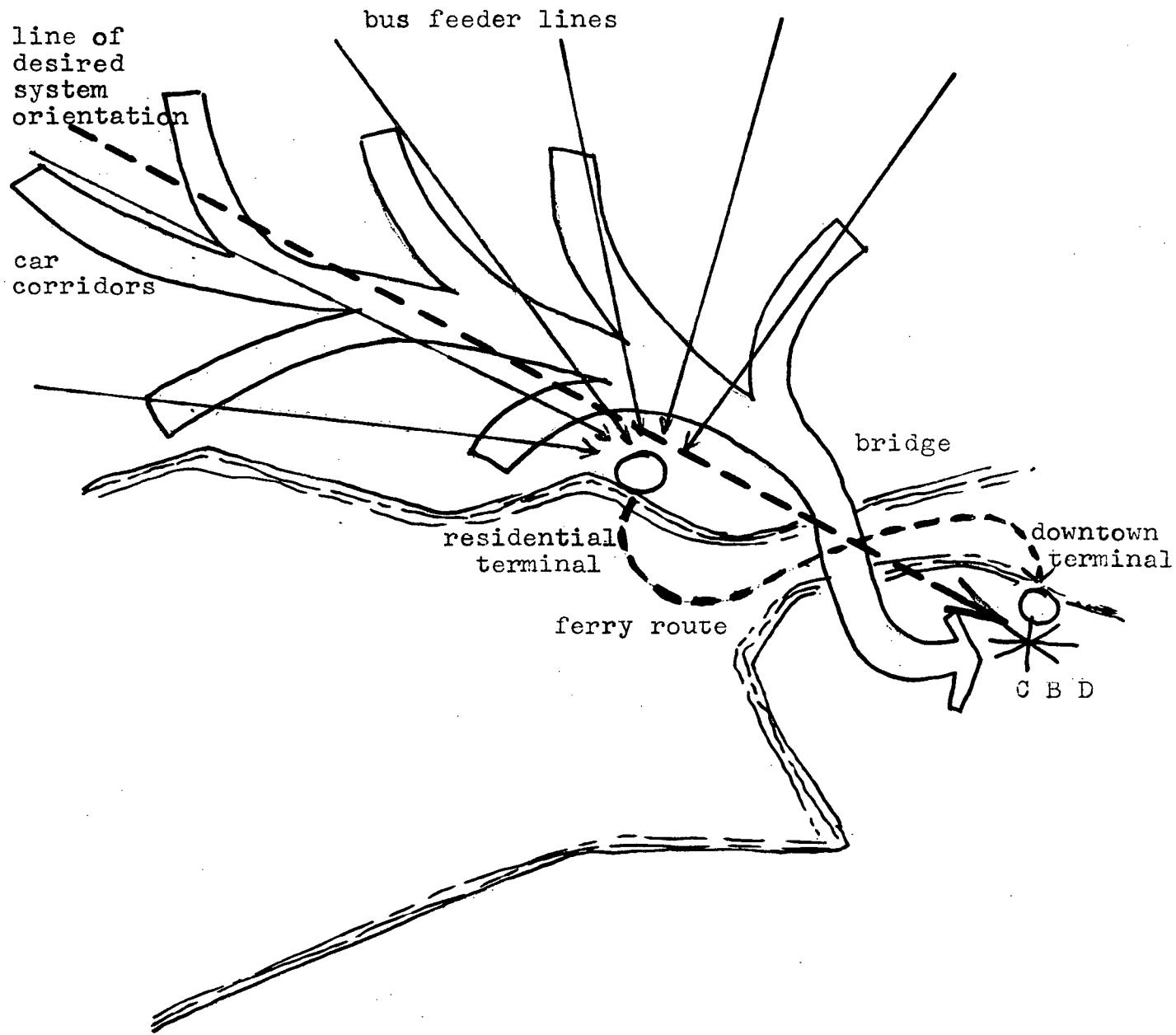


FIGURE 3 System Orientation

FIGURE 4 Walking Times from San Francisco Ferry Terminal

See: P. F. Spaulding and Associates, Inc., Golden Gate Commuter Ferryboat System (Seattle: P. F. Spaulding and Associates, Inc., 1970), p. 20.

Golden Gate Ferry planners estimated that a downtown terminal location at the old ferry landing would be within a 15 minute walking distance of 84 per cent of all downtown trip opportunities. A destination survey indicated that about 90% of all ferry users were in fact destined to the financial area which is within a 15 minute walking distance of the terminal (see figure 5). Likewise in Vancouver, a 1971 study of Harbour Ferry patrons shows that more than 80% of ferry trip destinations were within a ten minute walking distance of the ferry terminal (see figure 6).

Similarly, the locational policy must stipulate that the residential terminal is optimally located. Residential terminal location policy can stress certain locational criteria: One policy is to locate the terminal at a site that maximizes the number of existing commuters within some fixed radius. For West Vancouver, this policy would point to a terminal location at the bus depot in Ambleside, where fifty-three per cent of the commuters reside in a radius of five travel minutes by car. Alternatively, the location policy may stress the selection of a residential terminal site near to a major corridor or intersection where a majority of CBD commuters pass by. Again, for the West Vancouver situation, the location adhering to this policy would be near Taylor Way and Marine Drive, perhaps as part of the Park Royal complex. Finally, the locational policy may seek to balance bus access and ferry travel time to achieve some optimum among operating costs or infrastructure components. No example is readily available for West Vancouver without constraints and calculations.

These first two policies are quite inapplicable in two cases. First, if the systems and terminals are already in place, and second when the dynamics of urban growth have reduced their locational and orientational advantages. Furthermore, the two policies are generally linked together. The movement of the urban activity centre in time, does not give policy-makers

FIGURE 5 Destinations of Larkspur Ferry Commuters

See: Kenneth A. Hough, Analysis of Responses to Larkspur Ferry Questionnaires (San Francisco: Golden Gate Bridge, Highway and Transportation District, [1977]), Map 7.

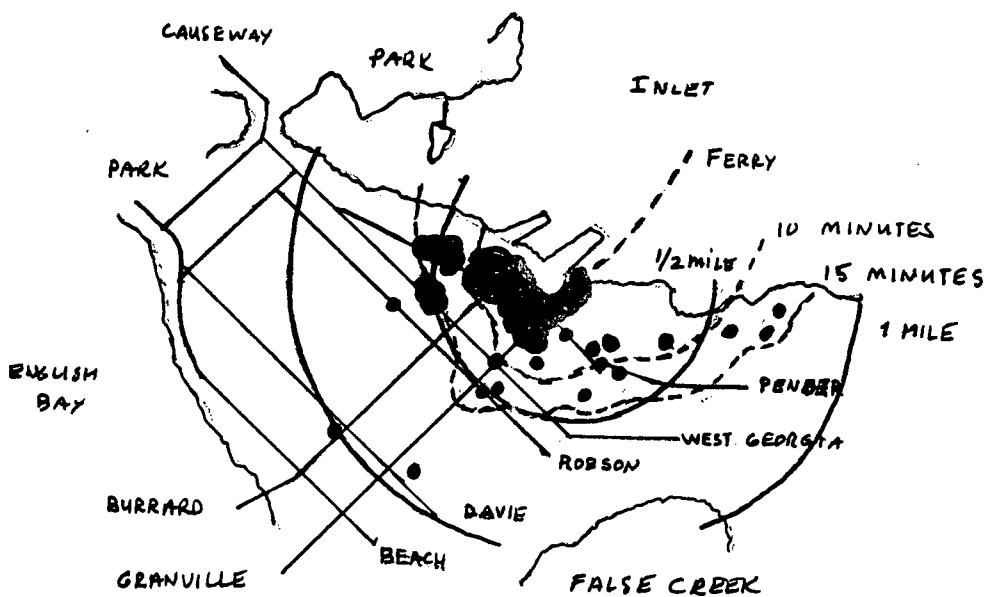


FIGURE 6 Destination and walking times of Harbour Ferries patrons in 1971

Based on: Associated Engineering Services Ltd., Burrard Inlet Ferry Crossing Study, a report prepared for the Greater Vancouver Regional District (Vancouver, B.C.: Greater Vancouver Regional District, 1971), figure 1; and Arthur Erickson Architects, Granville Waterfront Interchange, a report for the Bureau of Transit Services (Vancouver, B.C.: Arthur Erickson Architects, 1969), p. 10.

the flexibility of changing terminal location and hence system orientation or vice versa. Minor dislocations of terminal proximity and demand system orientation may only shift the required emphasis of policy to a new optimum among the group of downtown destinations described earlier.

Added flexibility is accommodated by the last four policy options:

(c) Provision of maximum connectivity

Connectivity has slightly different meanings in various fields in which it is used. Geography associates connectivity with graph theory and node-link systems, in order to visualize how well nodes are inter-connected. Planning uses connectivity in the sense of accessibility and the ease of mobility between various interconnected locations. In this section, connectivity is defined as how well different areas of a metropolitan area connected with each other⁵ and more specifically, how accessible the residential terminal is to its market area. This concept is extended to include the degree of choice and flexibility a patron has in reaching the residential terminal. The higher the connectivity advocated by policy, the higher is the attractiveness of ferry use to the commuter. Operationally, higher connectivity may be achieved by: (1) increasing the number of transit routes in residential area; (2) increasing route miles and system coverage; (3) increasing the number of bus stops on transit routes; (4) increasing the number of transit modes; and (5) allowing for auto access.

(d) Assurance of service reliability

A number of studies have indicated that service reliability is essential to attract transit patrons.⁶ This extends to ferry operations as well. Because a ferry operates as a major line-haul link, irregularities in service could have a disruptive network-wide impact, especially in the peak rush hour. A policy should require (1) strict adherence to

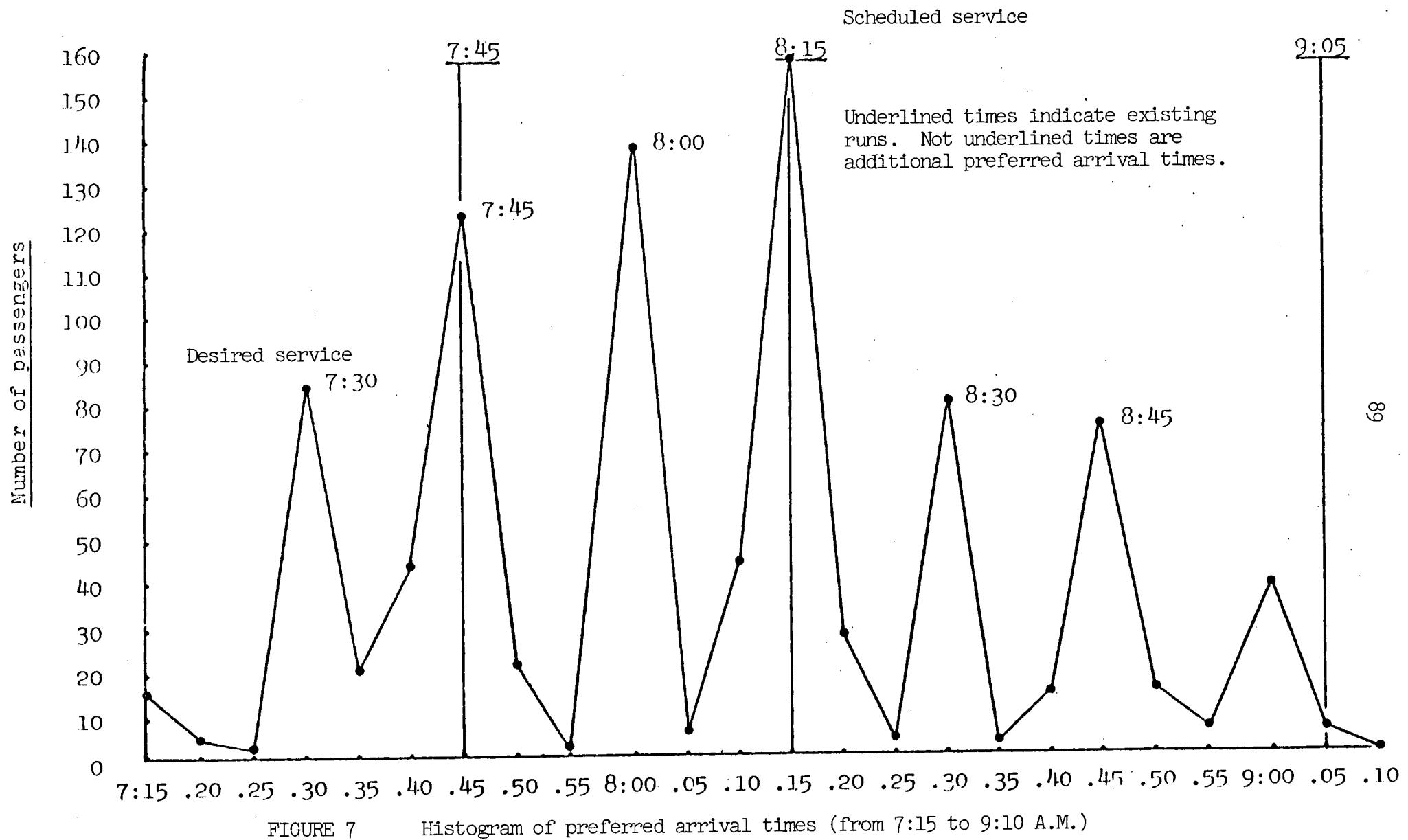
schedules, headways and posted crossing time; and 2) a regular preventative maintenance program to reduce mechanical failure of the vessel.

(e) Catering to preferred arrival/departure time

In addition to a policy of destination proximity, patronage levels can also be increased if scheduled arrival (and evening departure) times closely correspond to public preferences. Surveys by the Golden Gate Ferry indicate that a majority of commuters who do not ordinarily use the ferry, find the schedule does not fit their traveling needs.⁷ For example, the graph of preferred arrival times (see figure 7) illustrates that additional ferry service could be provided at 7:30, 8:00, 8:30 and 8:45. A ridership increase of 300 passengers could materialize by a policy to add these sailings. The number of available vessels, the burden of empty return sailings and the cost of additional service may influence an operator whether to meet each preferred arrival peak. Referring again to figure 7, the operator may find it advantageous to schedule the 7:30, 8:00 and 8:45 as extra runs. This assumes that many of those preferring an 8:30 arrival would not mind reaching their destination late.

(f) Provision of fully integrated transit

Ferry ridership may be increased by integration of the transit system with the ferry. The greatest ridership impact can be obtained if this network extends over an entire commuter shed. Furthermore, the integrated service requires the coordination of routes to arrive simultaneously with the arrival of the ferry and just before the ferry's departure. In other words, ferry terminals should become major timed transfer focal points in the regional network. Figure 8 is an example of a coordinated bus route schedule, in San Francisco.



Adapted from: K. A. Hough, Analysis of Responses to Larkspur Ferry Questionnaires
 (San Francisco: Golden Gate Bridge, Highway and Transportation
 District, 1977), p. 11.

Fairfax & Manor

19

ROUTE 19 to Larkspur Ferry Terminal
Manor - Fairfax - San Anselmo - Ross
College of Marin - Greenbrae
Larkspur Ferry Terminal

Monday through Friday except Holidays

Manor (Olmia & S.F. Drake)	Fairfax	Broadway & Buildings	San Anselmo	Ross	College of Marin	Greenbrae	Larkspur Ferry Terminal	Ferry leaves Larkspur	Ferry arrives S.F. Ferry Building
5 41	5 45	5 50	5 53	5 55	6 00	6 02		6 05	
6 03	6 13	6 48	6 52	6 54	6 58	7 02		7 05	
7 06	7 13	7 17	7 21	7 23	7 29	7 32		7 35	
8 06	8 10	8 17	8 21	8 23	8 29	8 32		8 35	
8 36	8 40	8 47	8 51	8 53	8 59	9 02		9 05	
9 39	9 43	9 50	9 54	9 56	10 02	10 06		10 15	
11 33	11 43	11 50	11 54	11 56	12 02	12 06		12 15	
1 39	1 43	1 50	1 54	1 56	2 02	2 06		2 15	
3 24	3 28	3 35	3 39	3 41	3 47	3 50		4 00	
3 59	4 03	4 10	4 14	4 16	4 22	4 25		4 35	
4 59	5 03	5 10	5 14	5 16	5 22	5 25		5 30	
5 34	5 38	5 45	5 49	5 51	5 57	6 00		6 05	
6 29	6 33	6 40	6 44	6 46	6 52	6 55		7 00	
								7 45	

19

ROUTE 19 from Larkspur Ferry Terminal
Larkspur Ferry Terminal -
Greenbrae - College of Marin
Ross - San Anselmo - Fairfax - Manor

Monday through Friday except Holidays

Ferry leaves S.F. Ferry Building	Ferry arrives Larkspur	Larkspur Ferry Terminal	Greenbrae	College of Marin	Ross	San Anselmo	Fairfax	Broadway & Buildings	Manor (Olmia & S.F. Drake)
6 50	7 30	7 35	7 38	7 41	7 46	7 50	7 56	8 00	8 30
7 20	8 30	8 35	8 38	8 41	8 46	8 50	8 56	9 00	9 30
9 05	9 30	9 05	9 08	9 14	9 16	9 20	9 26	9 30	9 40
9 20	10 05	10 15	10 18	10 24	10 26	10 30	10 36	10 40	10 45
11 15	12 05	12 15	12 18	12 24	12 26	12 30	12 36	12 40	12 45
1 15	2 05	2 15	2 18	2 24	2 26	2 30	2 36	2 40	2 45
3 10	3 55	4 00	4 03	4 09	4 11	4 15	4 21	4 25	4 30
3 50	4 30	4 35	4 38	4 44	4 46	4 50	4 56	5 00	5 05
4 45	5 25	5 30	5 33	5 39	5 41	5 45	5 51	5 55	5 60
5 20	6 00	6 05	6 08	6 14	6 16	6 20	6 26	6 30	6 35
6 15	6 55	7 00	7 03	7 09	7 11	7 15	7 21	7 25	
6 55	7 40	7 45	7 48	7 54	7 56	8 00	8 06	8 10	
7 50	8 35	8 40	8 43	8 49	8 51	8 55	9 01	9 05	

FIGURE 8 Schedule of integrated bus-ferry service

Source: Golden Gate Bridge, Highway and Transportation District,
Larkspur Ferry Timetable. June 4, 1978.

Evaluation of Operation-Oriented Policies

General studies have been carried out to determine the comparative importance of the six operations oriented policies.^{8,9,10,11,12} It would appear that system orientation, preferred arrival schedules and reliability of service are the three strongest policies to increase ridership. The next most important policy is transit integration. This is followed by destination proximity and connectivity. Generally speaking, these policies tend to hinge upon the conceptual variable of commutation time of the transit system as a whole. Hence the relative importance of each will be a function of the existing operating policies of a given ferry system; the most important one, therefore, is the one that is least reflected in the operation of an existing system.

Terminal-Oriented Policies to Increase Ferry Patronage

The use of mode-change facilities in urban trips may be a new experience for some commuters. Certainly, it is well known that transferring is a major unpleasant component for bus transit users. Therefore, terminal-oriented policies must minimize the disadvantage and maximize the benefits of the transfer procedure. These benefits include the opportunity to select routes or type of access mode and to take advantage of special amenities during any spare waiting time.

Patronage increasing policies for terminal use have two chief thrusts. First, they attempt to maximize the accessibility of the ferry system and second, to minimize the burden of the mode change process. Four policies are described below:

- (a) Provide maximum choice for access

Ferry ridership can be increased by providing the user with a choice of access modes. The greater the choice, the greater is the number of

attracted users. There are three basic mode access categories 1) pedestrian, 2) transit, and 3) private automobile. Pedestrian access provisions at the terminal should be able to accommodate walk-in and bicycle users. Transit should be provided with special, separate access privileges to and from the immediate terminal area. Depending upon the ferry system capacity and the extent of the passenger shed, a variety of transit systems can furnish terminal access. These may include: local, limited stop and express buses, commuter rail, light rail transit, para-transit and taxis. Sizable increases in ferry patronage may be obtained by allowing automobile access. Two forms of private automobile access can be provided: park-and-ride and kiss-and-ride. In areas where land values or space limitations prevent construction of low-cost parking facilities, park-and-ride may be strategically placed near freeway inter-sections, in commercial or institutional parking areas, provided that a free express bus service operates to the terminal.

(b) Minimization of walking distance

The major function of the ferry terminal is to facilitate modal transfer. The minimization of walking distances during the mode change is one way of achieving this parameter. It also reduces the commuter's dislike and frustration toward transferring. The physical design of the terminal must be capable of reducing distances between transferring tasks -- bus alighting, station entry, purchase of ticket, transfer processing, movement through turnstiles, and boarding the ferry. The reduction of distance may be attained from one of three policy variations: psychological distance reduction by providing special amenities, physical minimization between transferring tasks, and introducing some form of group rapid transit systems. This latter policy may include utilization of escalators, moving sidewalks, horizontal elevators or parking lot bus loops.

(c) Rapid and effective terminal movements.

The design of the terminal must facilitate four types of movements: pedestrian, ferry vessel, transit feeder/distributor and automobile. Policies must sort out these movements in such a way that conflicts among them are minimized, and that the holding areas of each individual movement are separated from the main flow streams. The typical relationship among these flows is depicted in figure 9.

Pedestrian movements, however, can be singled out as the ones requiring the greatest attention. Policies that minimize obstructions in the passenger stream and reduce confusion about circulation patterns make the ferry system more attractive to new patrons. There are two policies applicable for this purpose. First, terminal flows require separation by direction -- arrivals from departures, and second, the interfacing flow must not have constraints that impede the rapid loading and unloading of ferry passengers. These can be achieved by one of the following boarding/alighting methods: the "flow-through" process as used on Sea-Bus (see figure 10A) or by the "side-load" method utilized on the Golden Gate Ferry (see figure 10B).

(d) Provision of amenities

The burden of mode transfer can be further reduced by a policy of providing ample passive and functional amenity features in the terminal. Visual amenities can include special architectural treatment plus interior design and colour schemes. Together they help to create a more pleasant experience for the waiting and transferring patrons. Interior holding spaces such as lounges and waiting areas should dispel the feeling of crowding. Windows that reveal harbour views, interesting shore side activities and the berthing of the ferry are suitable in this respect. Certain comfort amenities, such as soft chairs, a television, no-smoking areas,

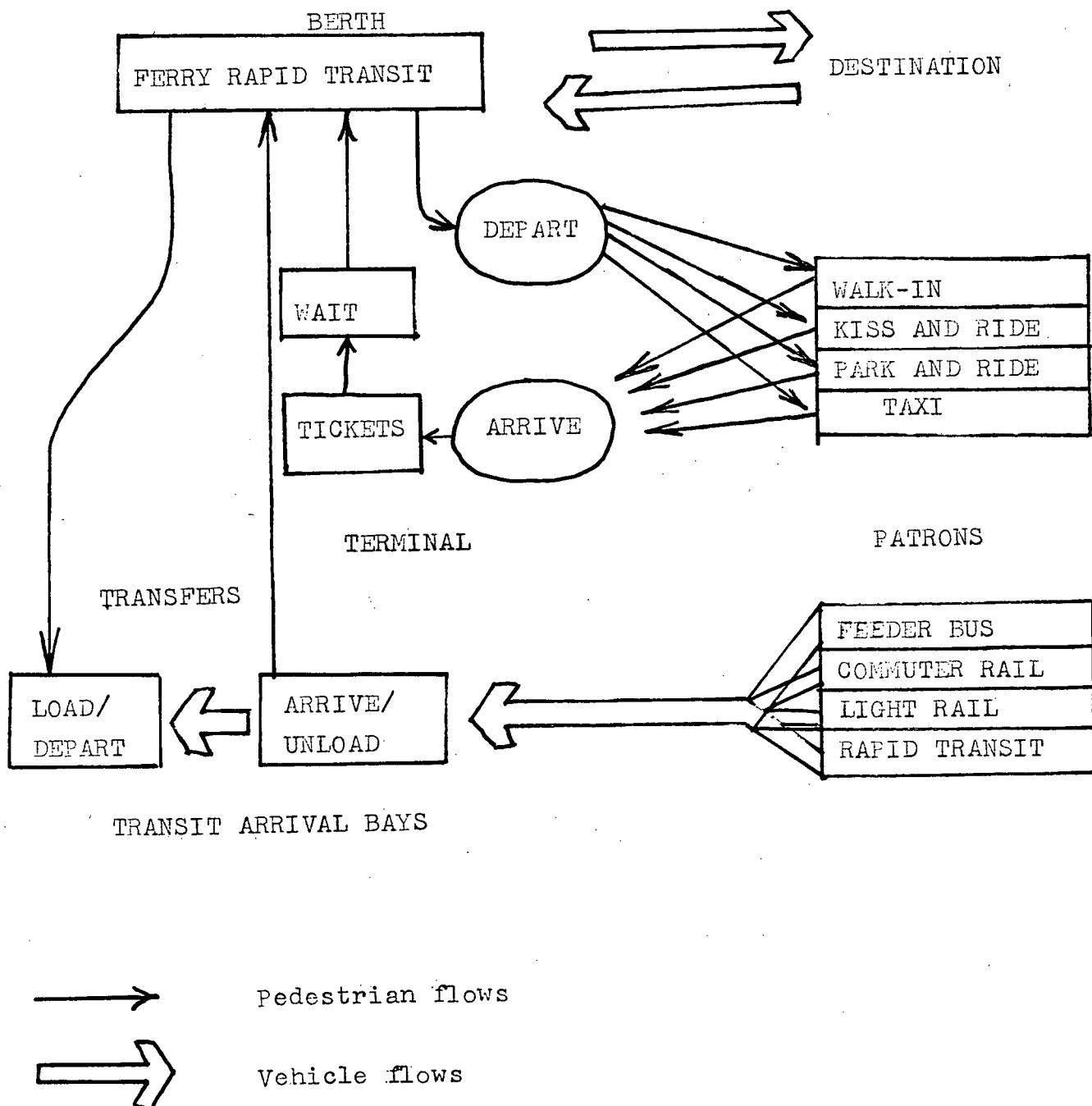
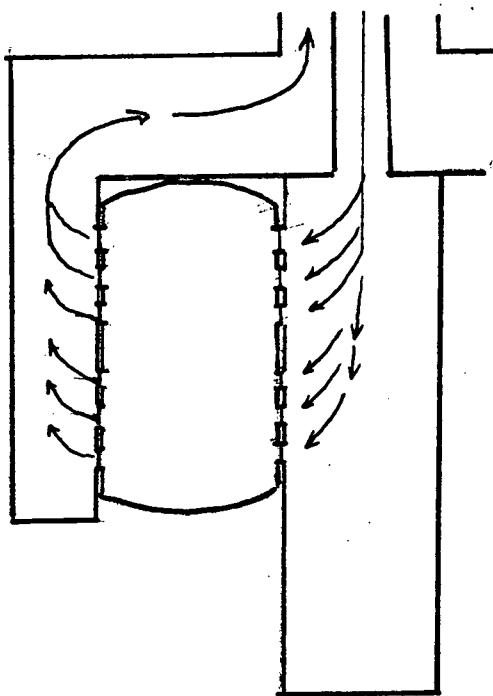
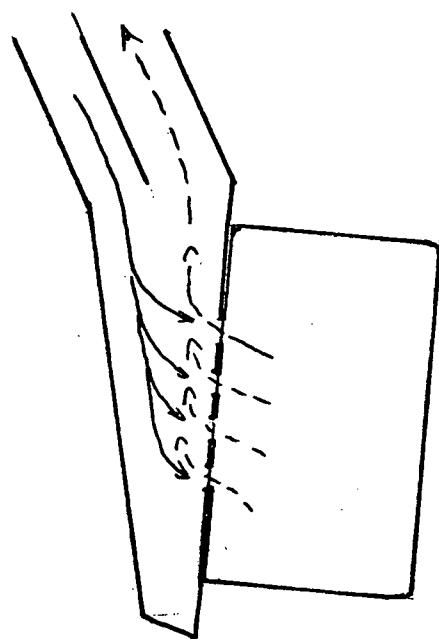


FIGURE 9 Terminal Circulation Patterns

Source: Prof. F. Navin, Civil Engineering 588 Lecture notes.



A Flow-through loading



B Side Loading

FIGURE 10 Ferry Loading Alternatives

carpets and bathrooms would reduce the discomfort of waiting to board.

The waiting areas can house special amenities like newspaper stands, telephones, bank-machines, small commercial concessions or other kiosks.

Finally, safety amenities such as closed-circuit television surveillance, open corridors, spacious waiting areas and fully illuminated facilities can enhance the image of the ferry system.

Evaluation of Terminal-Oriented Policies

The relative patronage increasing ability of each policy is highly dependent on the existing characteristics of a terminal and the nature of the ferry operation. If a terminal is significantly deficient in any one of the four policy directions discussed, correction would lead to inevitable ridership gains. It would also encourage the first time user to return and use the ferry regularly. In a broader overview, deficiencies in accessibility to or from the terminal and terminal movements, ought to be more vigorously pursued than lack of amenities or long walking distances. Accessibility and pedestrian movement policies have a greater ridership increasing capability on short ferry runs, while amenity policies have a greater potential in increasing patronage on long ferry routes. Policies to minimize walking distance often provide only marginal patronage increases, if used apart from other terminal or operation-oriented policies.

Vessel-Oriented Policies to Increase Ferry Patronage

Vessel or vehicular oriented policies, whether applied to design or refurbishing phases, may induce a ridership increase. One author writes that ridership levels and public perceptions of transit are highly sensitive to vehicle design and to the level of comfort and convenience offered to the passenger.¹³

Ferry operators have found that the inherent amenity of the ferry itself plus the provided on-board amenities, have a significant potential of drawing patrons. A San Francisco report¹⁴ predicted that ferry transit would achieve a 30 per cent ridership gain over a transit system with an equal commuting time. This effect is referred to as the "Amenity Factor." Ten vessel-oriented amenity policies are listed below:

- (a) Coordination of interior and exterior decor and colour schemes;
- (b) Extensive use of carpeting;
- (c) Providing soft, reclining chairs;
- (d) Various seating arrangements with the option of isolation or group conversations;
- (e) Installation of viewing windows;
- (f) Furnishing separate smoking/non-smoking areas;
- (g) Having an observation area and sun deck;
- (h) Selling coffee, snacks, and on evening return trips, cocktails;
- (i) Providing the option for light entertainment -- back-ground or piped music, television and electronic games;
- (j) Providing a high level of space for each passenger, comfortable dynamic characteristics and a pleasant internal environment (see figure 11).

Perhaps the ultimate in vessel-oriented policy, has been implemented on the Golden Gate's Larkspur ferry. The designers of the ferry, "placed great emphasis on special features to attract commuters." The Golden Gate Bridge, Highway and Transportation District, the ferry operators have:

...gone to a great effort to make the ferry-boats physically comfortable and visually appealing. Exposed metal is minimized to reduce noise and enhance the feeling of warmth. All seats are upholstered and have drop down trays for snacks or drinks. Floors are carpeted and ceilings are of acoustical tile. The silhouette of the vessels as well as other features were carefully selected to project images of speed and excitement but

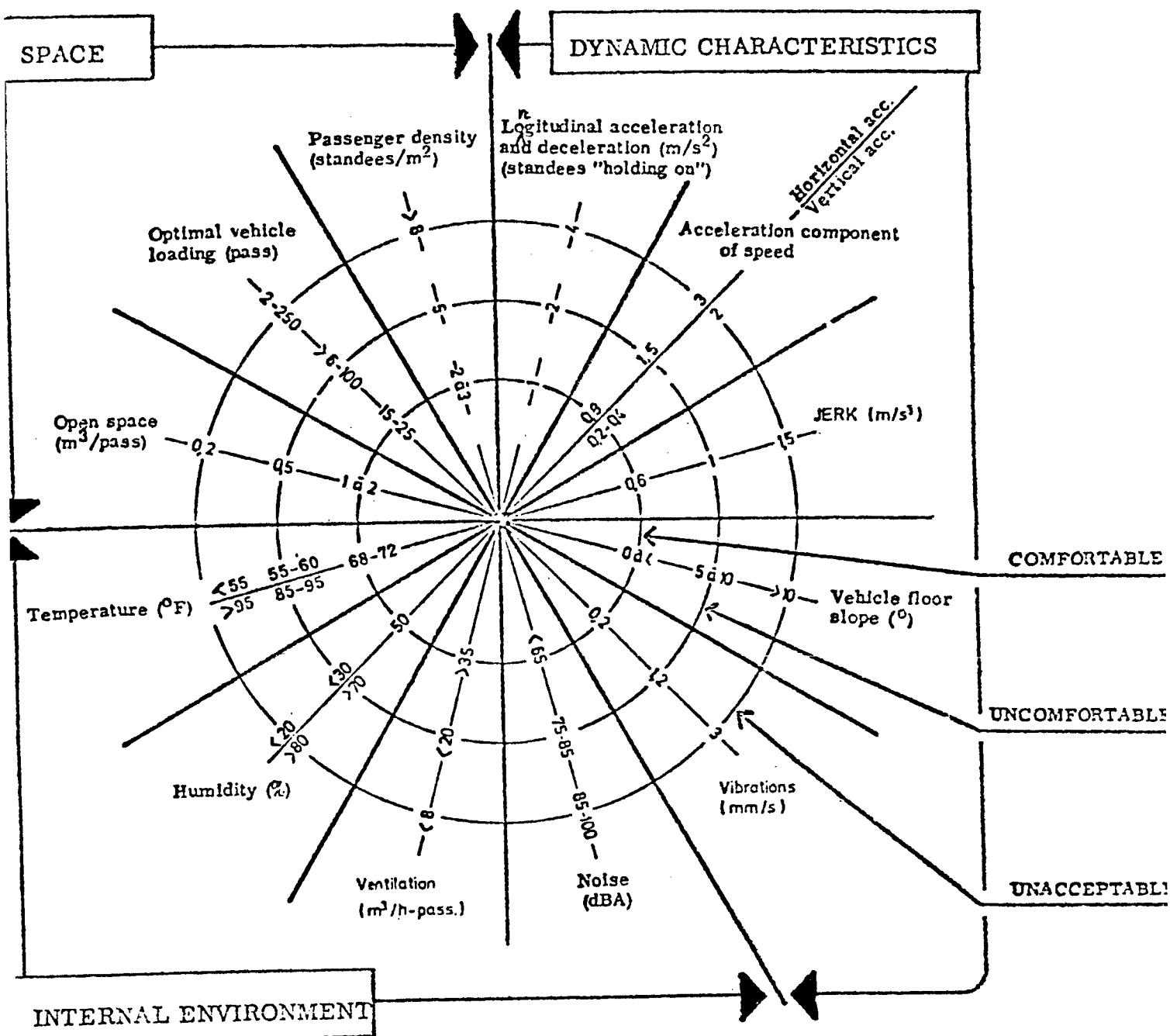


FIGURE 11

Principal recommendations for levels of comfort of urban public transport vehicles.

Source: Civil Engineering 587 lecture notes, Prof. F. Navin, September 25, 1978.

with a sense of comfort.. Uniforms are required to be worn by District personnel, to make their presence obvious and to project an image of professionalism. Careful selection of colors, paintings and fabrics give each of the vessels a personal touch....We also enhance the experience of the regular user by providing onboard entertainment such as fashion shows, bands and an upcoming backgammon tournament.¹⁵

Marketing Policies to Increase Ferry Patronage

Marketing policies have two functions. First, they must tie together operation, terminal and vessel-oriented policies to maximize their combined increasing attributes. Second, advertisement and promotional campaigns seek to penetrate, attract and influence the perceptions and attitudes of a target group of ferry commuters. Two policies are capable of increasing patronage in this regard:

(a) Provision of customer services

This group of policies include the distribution of time and fare schedules, route maps, brochures, plus the provision of telephone or visual information at bus stops, on the feeder buses, at the terminal and also on the ferry. Information handouts must be clear, clever and informative. Schedules, for example, must be simple to understand and easy to refer to by the commuter. Pocket or wallet-sized schedules (see figure 13) have been used successfully by Golden Gate Ferries. Similarly, the use of graphics and colour coded route maps, can simplify the access task in the mind of the user. Figures 14 and 15 provide good examples of high quality transit guide route maps. Visual information at stations -- which boarding gate to use, how to pay the fare, where to catch the bus, etc. -- attempt to dispell the new ferry commuter's fear of "getting lost" or being late, or looking foolish casting about for directions. Boarding and fare payment instructions for Sea-Bus at the Granville Water Front Interchange (the Canadian Pacific Rail terminal) are shown in figure 12. (in the pocket)

SAUSALITO				LARKSPUR							
GOLDEN GATE FERRY											
Telephones: S.F. 332-6600—Marin 453-2100											
Schedule No. 26 - Effective December 1978											
Service to and from S.F. Ferry Building											
WEEKDAYS (except holidays)											
Sausalito S.F.		S.F. Sausalito		Larkspur S.F.		S.F. Larkspur					
Lv.	Arr.	Lv.	Arr.	Lv.	Arr.	Lv.	Arr.				
7:15	7:45	7:50	8:20	6:05	6:45	6:50	7:30				
8:25	8:55	10:25	10:55	7:05	7:45	7:50	8:30				
11:05	11:35	11:45	12:15	7:35	8:15	8:20	9:00				
12:25	12:55	1:10	1:40	8:35	9:15	9:20	10:05				
1:55	2:25	2:35	3:05	9:05	9:50						
3:15	3:45	3:55	4:25	10:10	10:50	10:55	11:40				
4:45	5:15	5:30	6:00	11:45	12:35	12:45	1:35				
6:10	6:40	6:50	7:20	1:45	2:35	2:50	3:40				
7:30	8:00	8:10	8:40	3:45	4:35	3:50	4:30				
SATURDAY, SUNDAY AND HOLIDAYS											
Sausalito S.F.		S.F. Sausalito		Larkspur S.F.		S.F. Larkspur					
Lv.	Arr.	Lv.	Arr.	Lv.	Arr.	Lv.	Arr.				
9:20	9:50	10:00	10:30	10:50	11:40	11:50	12:40				
10:40	11:10	11:25	11:55	12:50	1:40	1:50	2:40				
12:15	12:45	1:00	1:30	2:50	3:40	3:50	4:40				
1:40	2:10	2:25	2:55	4:50	5:40	5:50	6:40				
3:15	3:45	4:00	4:30								
4:40	5:10	5:25	5:55								
6:15	6:45	7:00	7:30								
7:40	8:10	8:20	8:50								
Holidays—New Year, Washington, Memorial, Independence and Labor Days											
NO SERVICE ON THANKSGIVING AND CHRISTMAS DAYS											
HOLIDAYS — SEE OTHER SIDE											

FIGURE 13 Golden Gate's pocket sized ferry schedule

Source: Golden Gate Bridge, Highway and Transportation District, 1978

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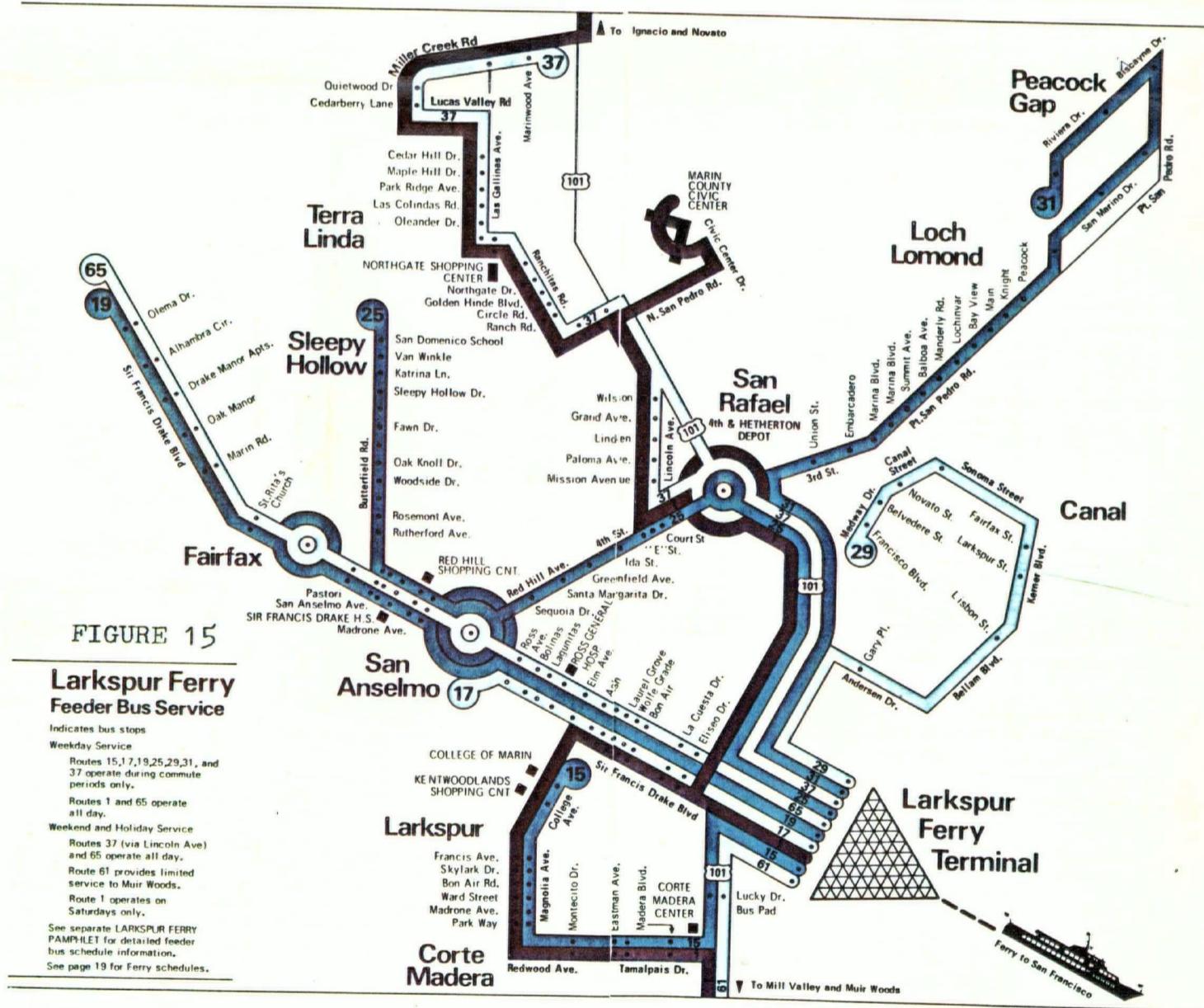
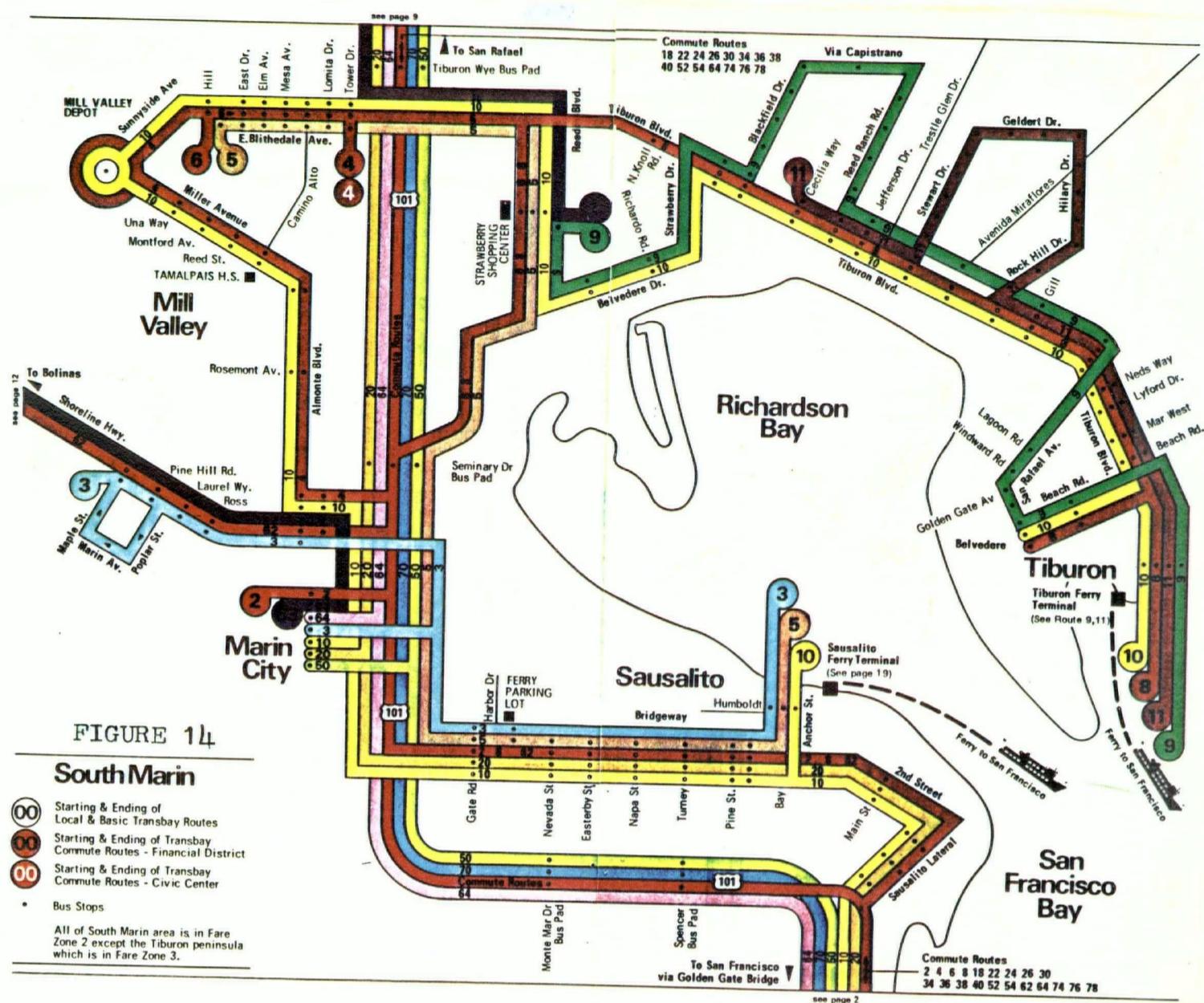
FIGURE 14 Sausalito Ferry Feeder Route Map

Source: Golden Gate Bridge, Highway and Transportation District, Golden Gate Transit Guide (San Francisco: Golden Gate Bridge, Highway and Transportation District, 1977), p. 6-7

(SEE XEROX COPY ON NEXT PAGE)

FIGURE 15 Larkspur Ferry Feeder Route Map

Source: Golden Gate Bridge, Highway and Transportation District, Golden Gate Transit Guide (San Francisco: Golden Gate Bridge, highway and Transportation District, 1977), pp. 14-15



(b) Sales promotions

Customer awareness and appreciation of ferry service as an alternative to the car or other modes of transit, is a primary step in increasing patronage. Promotions must focus on operation, terminal and vessel characteristic plus the inherent amenities of fresh air, a beautiful view, continuous ride, no congestion, no driving frustration, etc. Radio and newspaper advertising and mailing of schedules to each household in the ridership shed, are an effective means of sales promotion. Two sample brochures (figures 16 and 17, in pocket) are examples of Sea-Bus promotional campaigns. Various promotional activities can be designed in encouraging people to try the ferry, such as passing out free tickets, conventional media advertising, on-board contests and the like.

Land-Use Policies to Increase Ferry Patronage

A medium to long term policy would encourage or actually instigate land use planning to locate trip generating facilities in the immediate vicinity of the residential and downtown terminals. Location of trip generators at the residential terminal may increase ridership by inducing use of the ferry upon its return trips from the downtown. Care must be taken to select such facilities that would not detract from the number of downtown destined patrons. These would include large shopping malls, branches of universities, major suburban college campuses, tourist and cultural attractions, plus recreation and commercial sports stadiums. Downtown terminals could become trip generators in themselves if built as part of an office building complex. Above or below ground concourses could link the terminal with existing waterfront development as well. An example of integrating a ferry terminal to downtown employment areas by a pedestrian walk way system, is illustrated by a Halifax proposal in figure 18. A Dartmouth scheme to develop an office complex as

FIGURE 18 Site plan of Halifax ferry terminal

See: Development Planning Associates, Ltd. Halifax-Dartmouth Ferry Study (Dartmouth, N.S.: City of Dartmouth, 1976), Exhibit II-2.

FIGURE 19 Site plan of Dartmouth ferry terminal

See: Development Planning Associates, Ltd., Halifax-Dartmouth Ferry Study (Dartmouth, N.S.: City of Dartmouth, 1976), Exhibit III-4.

FIGURE 20 San Francisco ferry terminal facilities

See: P. F. Spaulding and Associates, Inc., Golden Gate Commuter Ferryboat System (Seattle: P. F. Spaulding and Associates, Inc., 1970), p. 40.

part of a new ferry terminal is shown in figure 19. Finally, a combination of both existing and ferry related development in a downtown San Francisco, is shown in figure 20. Ferry terminal development can assure a steady, long term source of increasing patronage.

Toward the Selection of a Policy Framework

With the individual policies identified, it is possible to select an appropriate policy framework. Depending on the operating goals and the availability of funds, there is an unlimited number of variations to the policy format that can be implemented.

The process of selecting the most favourable policy framework requires an assessment of the combined cost-effectiveness of each policy, accounting for the various physical constraints of the crossing, and keeping patronage to within the capacity limitation of the system. In the first instance the effectiveness of patronage increasing policies may differ depending upon whether a system is established or in the design phase. It is intuitive that a system having a high level of convenience would not benefit as much from adopting a policy to increase convenience as would a system with a lesser degree of convenience. Assuming the same expenditure is involved in each instance, the policy would be more cost-effective, for the latter than for the former. system.

If a function

$$f(o,t,v,m)$$

could express the unit cost of increasing the patronage (p) for each operation-oriented (o), terminal-oriented (t), vessel-oriented (v) and marketing (m) policy, then the most cost-effective policy framework would minimize this function with respect to cost (E), or:

$$\frac{\partial P}{\partial E} = \frac{\partial}{\partial E} [f(o, t, v, m)]$$

where the function is a minimum when

$$\frac{\partial P}{\partial E} = 0$$

Theoretically, given a set of equations that specify the system, operating and physical constraints, an optimum policy framework can be obtained from the solution to this expression.

A less rigorous way of assembling a policy framework is based on trade-offs among policy concerns. When dealing with the variable of distance, different policies are applicable to short and long ferry runs. The basic trade-off becomes -- the longer the travel distance (less time savings), the more importance is attached to increasing on-board amenities. Stated in another way, a person is willing to forego time saving if an adequate amount of vessel amenities are provided. A second trade-off involves vessel speed. For trips that take a long period of time, reduction of travel time can be achieved by utilizing a vessel technology capable of sailing faster. The trade-off is -- the longer the commuting time, the more advisable it is to increase the block speed of the ferry. A third trade-off states -- the shorter the route distance (travel time) the more important are savings in loading/unloading, waiting and accessing at the terminal. Hence, a clear distinction arises for patronage increasing policies, when distance is involved: the longer the route, the more success can be obtained by vessel-oriented policies; while the shorter the route, more stress should be placed upon terminal-oriented policies.

Trade-off performed when the distance variable is a constant, emphasizes the importance of both operation-oriented and terminal-oriented policies. For short ferry routes, the first trade-off is -- the more continuous the ferry ride, the less the disamenity of accessing and transferring becomes to the commuter. Referring to the distance-time diagram in figure 21, a commute by

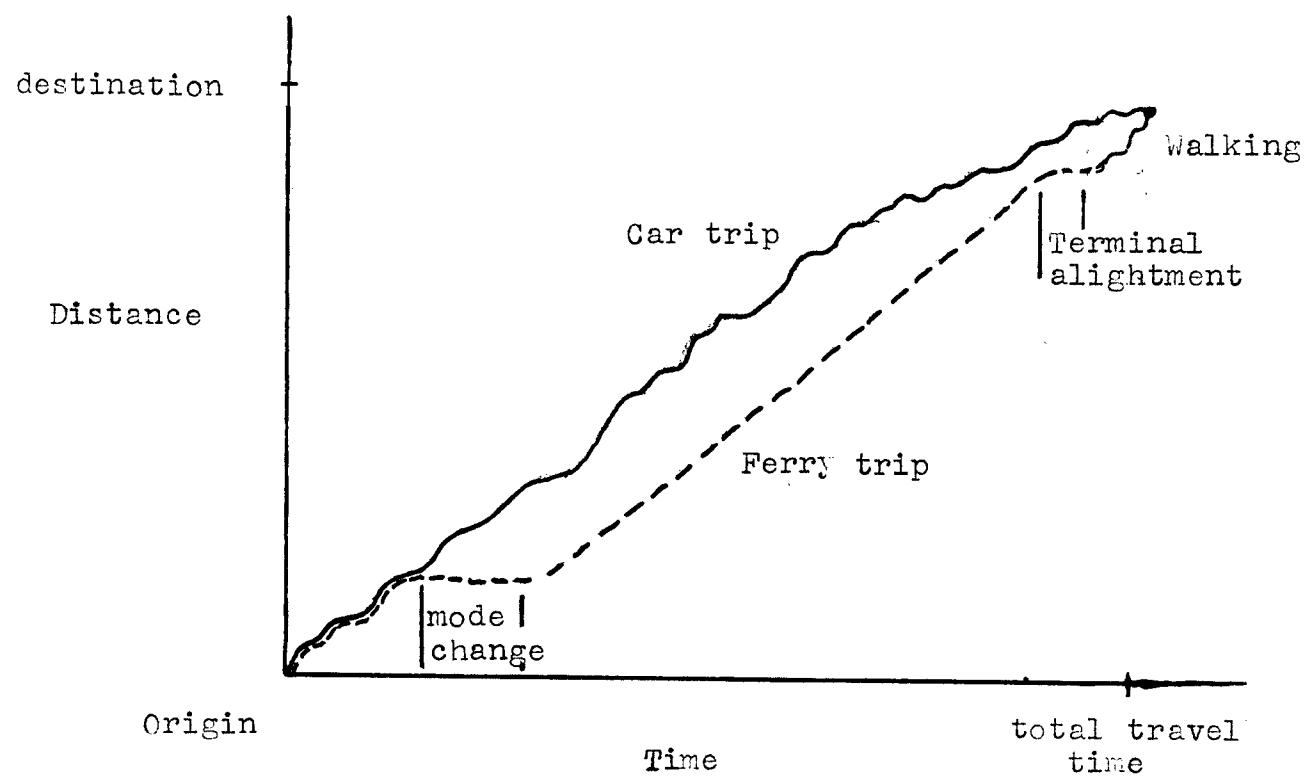


FIGURE 21 Distance-time diagram comparing a car trip with a ferry trip.

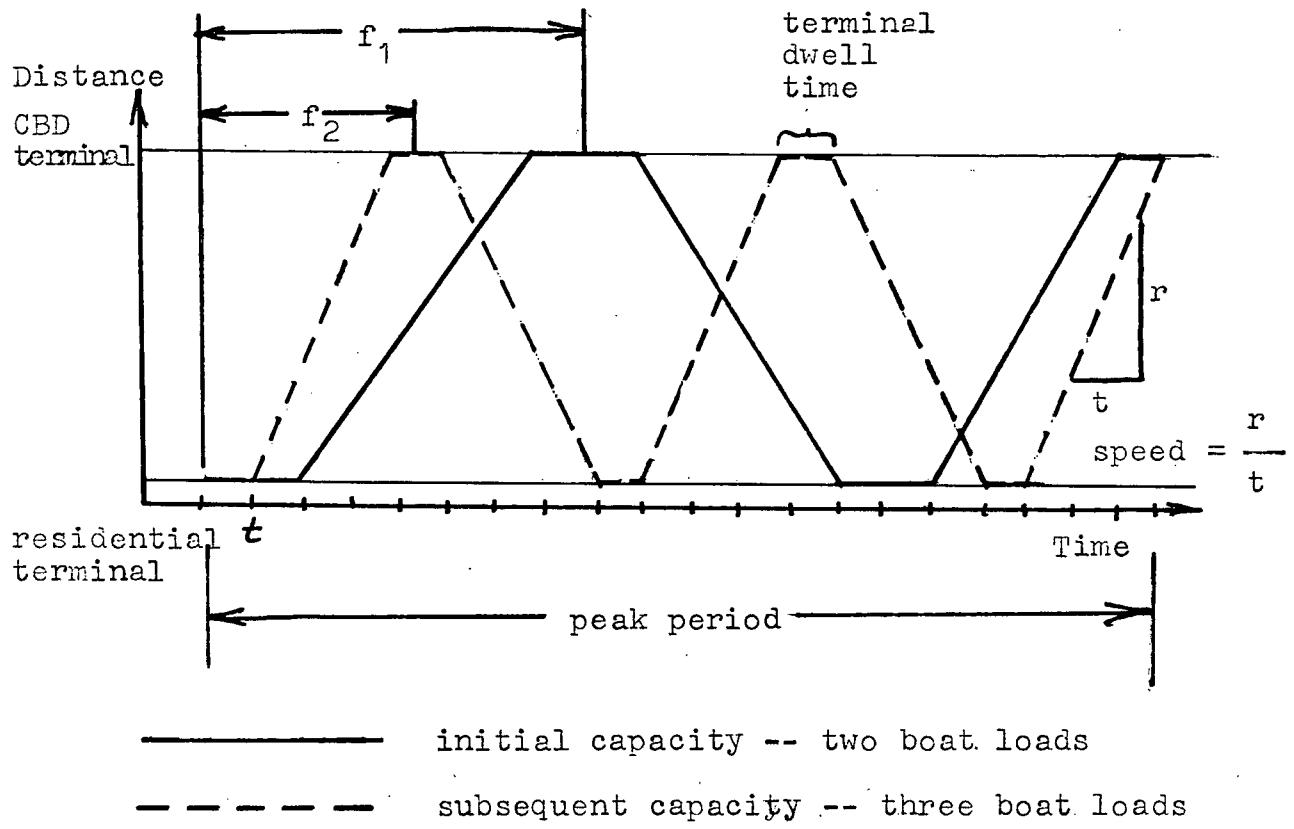


FIGURE 22 Effect of higher speed and shorter dwell time on ferry capacity in the peak direction

ferry replaces the stop-and-go pace of car travel (solid line) by a smooth, non-stop ride (dotted line). Ride continuity as a type of operation-oriented policy, directly compensates for time lost in mode change. The second trade-off in short route systems is -- the greater the number of access opportunities (including both mode type and bus route variety) the less inconvenient the transfer becomes. A corollary to this trade-off is -- the less the access opportunities, the more terminal amenities should be provided. Both these trade-offs signify the importance of terminal-oriented policies to short distance ferry routes.

Any envisioned patronage increase must lie within the proposed physical or operational capacity of the system. One way of accommodating extra ridership is to add vehicles and increase the frequency of service. The added number of sailings translates into a greater total crossing capacity. However, operation-oriented policies, on short ferry routes, can be used to increase the system's over-the-water capacity, without adding new vessels. The frequency of the system can be increased by: 1) increasing the block speed in order to shorten sailing time; 2) reduce the time consumed loading and unloading passengers; 3) reduce the layover (idle) time; and 4) any combination of the above. By way of another time-distance diagram (figure 22), a hypothetical system's capacity can be shown to increase from two to three ship loads of passengers, by implementing all three of the operation-oriented policies.

Findings

A number of potential policy options, capable to increase ferry patronage have been identified. They include policies that are vessel-oriented, operation-oriented, terminal-oriented, and relate to marketing and land use. Their effect is dependent on which individual policies are assembled into a policy

framework. The type of terminal, operating practices and system goals also influence the impact of the policy framework.

Selection of the policy framework can best be achieved by a cost-effectiveness analysis. However, the mechanism of cost-effectiveness can be approximated qualitatively, based upon certain trade-offs. Five simple trade-offs were established:

- 1) distance (time) with amenity;
- 2) time with speed;
- 3) travel time with loading/unloading time;
- 4) ride quality with transfer convenience and;
- 5) transferring with access opportunities.

The cost-effectiveness of a patronage increasing policy is also constrained by the system's physical capacity. Enlarging capacity requires more frequent over-the-water crossing. This can be achieved by adding vessels or by operating the system more efficiently -- quicker loading and unloading, higher block speed, less layover.

In conclusion, the identified policies and the applicable trade-off parameters are summarized in the table that follows.

SYNOPSIS OF POLICIES TO INCREASE FERRY PATRONAGE

TABLE 1

ORIGIN*	POLICY	DISTANCE*	TRADE OFFS
<u>Operations-Oriented</u>			
R	• System Orientation	s/l	time, distance
H O	• Destination Proximity	s	time
H	• Connectivity	s	access
R O	• Service Reliability	s/l	time, distance
R O	• Preferred Arrival Times	s/l	time
H R O	• Integrated Transit Feeders	s	time, access
<u>Terminal-Oriented</u>			
H	• Access Choice		
A O	- transit	s/l	access
A O	- park-and-ride	s/l	access
A O	- park-and-ride hybrid	s/l	access, time
	- kiss-and-ride	s/l	access
H R	• Minimize Walking Distance		
O	- physical design	s	access, time
R O A	- perceptional devices	s/l	access
	- technological systems	s/l	access, time
R O	• Terminal Flows		
	- separated by mode and direction	s/l	access
R O	- effective interfacing	s	access
O	• Amenities		
R O H	- visual	s/l	time, access, distance
R O A	- design	s/l	time, access, distance
H	- comfort	l	time, access, distance
	- safety		--
<u>Vessel-Oriented</u>			
O A	• Amenities		
H R O A	- visual	l	time, distance
O R A	- design	s/l	time, distance
H	- comfort	l	time, distance
O	- safety		--
	- special	l	time
<u>Marketing</u>			
R O	• Customer Services		
O	- inform the public	s/l	--
O	- fare payment schemes	s/l	access
	• Promotion	s/l	--
<u>Land Use</u>			
O	• Ferry Served Development	--	--

* Key: H = Historical; A = Advocate; R = Revitalization

O = Operating Principles. s = short distance, l = long distance.

FOOTNOTES

¹ Roman Krzyczkowski, Over-the-Water Program Design, Volume 3. (Springfield, Va.: National Technical Information Service, PB-216-068 1971), pp. 137-143.

² Civil Engineering 587 lecture, by Professor F. Navin on September 27, 1978.

³ Golden Gate Bridge, Highway and Transportation District, Golden Gate Ferry (San Francisco: Golden Gate Bridge, Highway and Transportation District, 1979), p. 12.

⁴ Gregory L. Thompson, A Macro Analysis of Variables Influencing Transit Usage (Victoria, B.C.: British Columbia Bureau of Transit Services, 1973), p. 7.

⁵ Kates, Peat, Marwick and Company, Transportation Services Measures, a report prepared for the Greater Vancouver Regional District. (Vancouver, B.C.: Greater Vancouver Regional District, 1973), p. 1-2.

⁶ Gordon J. Fielding, Douglas P. Blankenship and Timothy Tardiff, "Consumer Attitudes Toward Public Transit." Transportation Research Board 563 (1976) p. 23.

⁷ Kenneth A. Hough, Analysis of Responses to Larkspur Ferry Questionnaire (San Francisco: Golden Gate Bridge, Highway and Transportation District, [1977]), p. A-5.

⁸ Thompson, op. cit., pp. 14-16.

⁹ Hough, op. cit., pp. 10-17.

¹⁰ A.D. Little, Inc., Feasibility Study of San Francisco - Marin Ferry System. (San Francisco: A.D. Little, Inc., 1969), p. 33.

¹¹ J.J. Haynes, "Public Attitude Toward Transit Features and Systems." Transportation Research Board 649 (1977) 48.

¹² Ricardo Dobson and Mary Lynn Tischer, "Comparative Analysis of Determinants of Modal Choices by CBD Workers," Transportation Research Board 649 (1977) 10.

¹³ Transport Canada, The Fundamentals of Urban Transit (Unedited Working Paper) (Ottawa,: Department of Supply and Services, 1978), p.8-1.

¹⁴ Peat, Marwick, Mitchell and Company, Modal Split Model, prepared for the Golden Gate Bridge, Highway and Transportation District. (San Francisco: Golden Gate Bridge, Highway and Transportation District, [1970]). p. 2.

¹⁵ Personal correspondence from Mr. Jerome M. Kuykendall, Assistant General Manager for Planning and Research, Golden Gate Bridge, Highway and Transportation District, March 13, 1979.

CHAPTER FIVE WEST VANCOUVER FERRY CASE STUDYIntroduction: Geography, Demographics and Transportation

West Vancouver is an affluent residential suburb northwest of downtown Vancouver (see figure 1). The high coastal range mountains constrain residential neighbourhood to within a mile of waterfront. In the eastern part of the District, the built up area extends to the 1200' elevation, and follows the Capilano Canyon to Cleveland Dam. West Vancouver includes a series of villages -- Horseshoe Bay, Caulfeild, West Bay, Dundarave and Ambleside. Park Royal is a major commercial mall, that attracts customers from much of the Lower Mainland.

The 1976 census population of West Vancouver is 37,389. About 72 per cent of the population is over the age of 19 and 20 per cent is over the age of 60. The size of the labour force is estimated at 21,930. The average annual income based upon tax returns filed in West Vancouver is \$15,478.¹

The passenger transportation system in West Vancouver consists of roads, highways and buses. A gridiron road system is imposed on the Ambleside-Dundarave area, which gives way to a contoured road system in the British Properties. Marine Drive is the major east-west urban arterial, linking all the waterfront villages between Horseshoe Bay and the Lions' Gate Bridge. The primary north-south arterial is Taylor Way, between Park Royal and the British Properties. Secondary north-south arterials are 26th and 15th streets. The Upper Levels Highway is a major east-west provincial expressway to Horseshoe Bay. Taylor Way links the highway to the Lions' Gate Bridge. Transit in the community is provided by the municipality owned "Blue Bus System". Four fixed routes are operated, three of which are trans-bridge service to Vancouver. During the morning two hour peak, 21 - 25

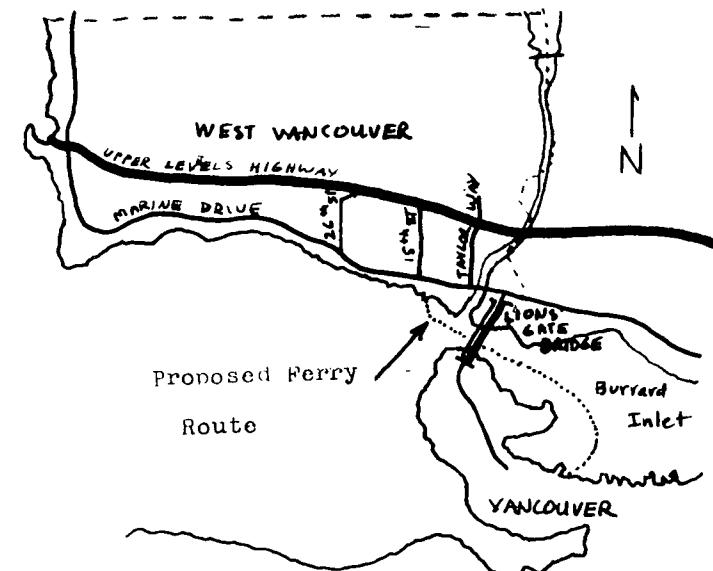
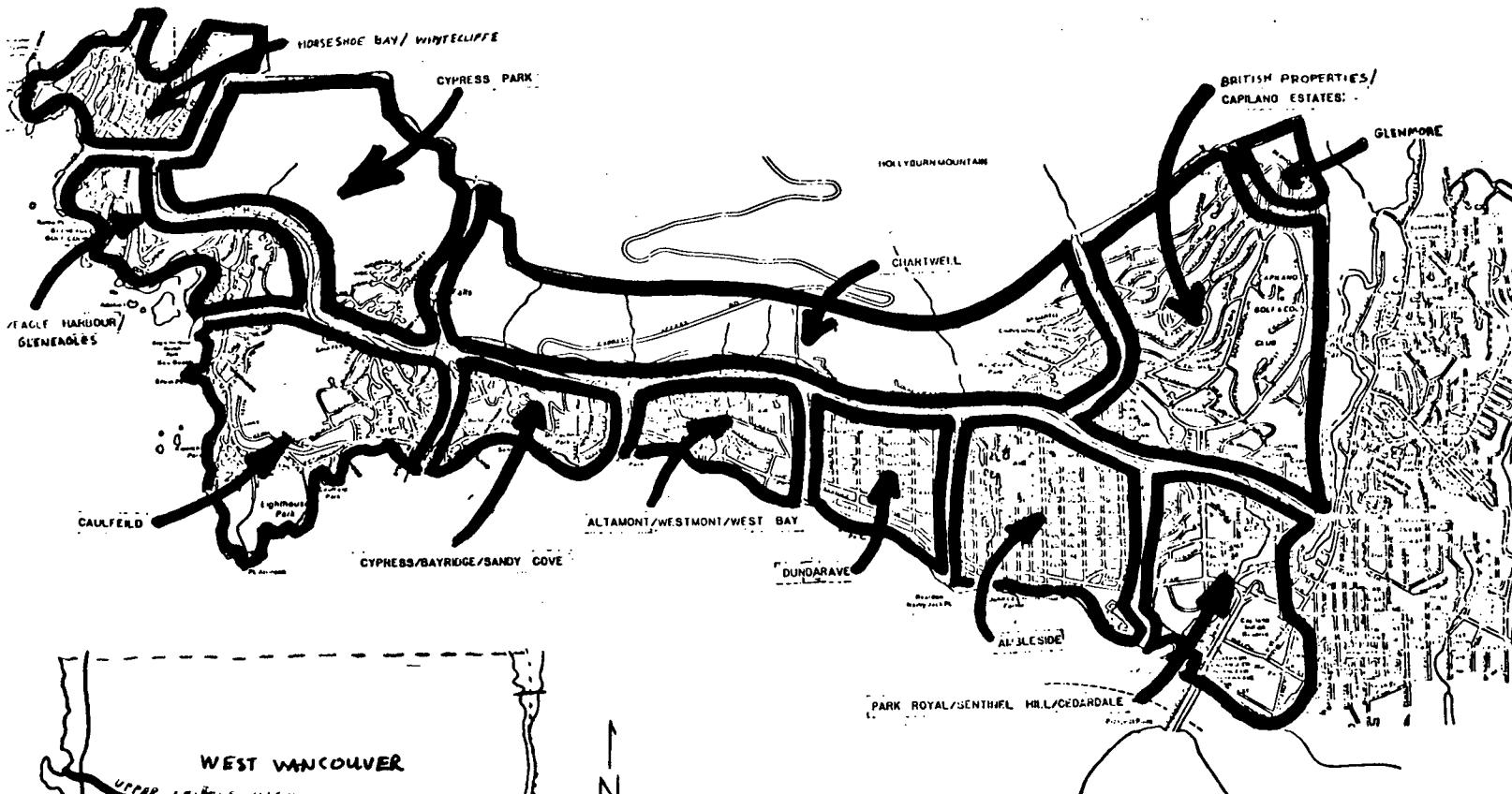


FIGURE 1 Vancouver and West Vancouver

Adapted from: A. Kopystynski, Analysis of Selected Citizen Survey Questions (West Vancouver, B.C.: Department of Development and Planning, 1978), Figure 1.

buses operate into the city. In the evening rush, 25 - 30 buses provide a return trip.

A majority of transit and auto trips are for work purposes. Nearly three-quarters of them are destined to points outside of the West Vancouver. Work trips to downtown Vancouver comprise 48 per cent of all destinations. By mode, 54 per cent of all car trips and 95 per cent of all bus trips are destined for downtown Vancouver. This translates into about 10,000 daily work trips to the downtown from West Vancouver.²

Case Study: West Vancouver Ferry

Background

The issue of a West Vancouver Ferry, from Ambleside to Vancouver (CBD) has been shrouded in political uncertainty and secrecy. The first suggestion for some form of cross-Inlet ferry service, came in the 1971 Kelly Report. Sullivan discussed the potential of a ferry service between Vancouver and North Vancouver in his bus improvement report of the same year. Following the election of the NDP as the Provincial government in 1971, various G.V.R.D. and Provincial in-house discussions about transit took place. Questions revolved around which of the two former ferry routes were to be selected -- Ambleside or North Vancouver. By 1973, the ferry concept had been upgraded from that of "water taxi" to the status of a "major link" in the regional transit network.³ Finally, without any prior consultation with West Vancouver officials, the North Vancouver route was chosen by 1975.⁴

West Vancouver had long favoured some form of additional cross-Inlet capacity. With the rejection of a third bridge crossing in 1973, emphasis was placed on selective road construction and the development of some sort of rapid transit link between West Vancouver and downtown Vancouver. In a 1978 Council memorandum, former Mayor Peter Jones stated, "...on an interim

basis, such a [transit only] facility could consist of an improved bus ferry-transit system,...moving people from various North Shore places including 'downtown' West Vancouver to 'downtown' Vancouver...."⁵ Provincial authorities and the Urban Transit Authority (formerly the Bureau of Transit Services) offered no comment about a future option to extend the Sea-Bus or a provision of any other form of rapid transit to West Vancouver.⁶ This case study singles out the option of providing Sea-Bus to West Vancouver for a feasibility analysis.

Physical Description

The proposed ferry route would operate from the foot of 14th Avenue in West Vancouver, to the existing Sea-Bus terminal on the South Shore of Burrard Inlet in downtown Vancouver. The West Vancouver residential terminal is sited at the present bus depot property which was the original terminal location for the Ambleside ferry. The route length is 3.5 nautical (4.0 statute) miles. A third of the sailing route will be on the waters of the Outer Harbour, and will require passage under the Lions' Gate Bridge. Assuming a block speed of 13.5 to 14 knots (15-16 miles) per hour, the crossing can be completed in about fifteen minutes.

The vessel to be used for this proposed service is the Case Existological Sea-Bus catamaran ferry that is currently operating on the North Vancouver route. In this manner, the two routes could utilize a common South Shore terminal and the North Shore maintenance berth. The proposed West Vancouver ferry terminal would be similar to the floating terminals in use by Sea-Bus at North Vancouver and Vancouver. (fuller description provided in Appendix 5).

Classification, Trade-offs and Policy Framework

The system is a short haul route, similar to the Sausalito ferry, but somewhat longer than the local Sea-Bus service. The distance does not require a high speed vessel technology; a Sea-Bus type vehicle would suffice. Since it is a short run, few vessel amenities are required. However, a rearrangement of existing Sea-Bus seating, to allow for group conversations and fold down trays should be a policy item. Sailing time is sufficient to allow for sale of coffee and pre-packaged snacks on morning service and cocktails on the evening return service. Overall, the inherent plus added amenities would have a far smaller passenger attracting ability than on the Sausalito and Larkspar routes.⁷

The shortness of the route requires greater emphasis on operations policy and policies to reduce transfer resistance and facilitate quick access and interfacing at the departure terminal. The first operations-oriented policy must stipulate that schedule preferences ought to be accommodated as well as possible without requiring more than three vessels. Therefore, arrivals cannot be scheduled at closer than fourteen minute intervals with three sea-bus vessels. Secondly, the municipal bus network must be re-organized to complement the ferry system orientation. No policy action is required for system orientation or destination proximity. Thirdly, connectivity is best achieved by stressing both car and bus access. Service may later warrant the addition of a light rail feeder system using B.C. Railway right-of-way, between Horseshoe Bay and the ferry terminal. Higher connectivity can be immediately achieved by utilizing the buses diverted from trans-bridge operation, on various local feeder routes. Hence, the terminal is to be developed as a major time transfer focal point for local and B.C. Hydro North Shore buses, car users and future light rail.

Terminal-oriented policies require the attainment of a medium level of

access in the short run. Access choice is to be provided by bus, park-and ride and kiss-and-ride facilities. There appears to be little need for a policy to reduce walking distances. Terminal flows, however, require special attention to reduce pedestrian and vehicular movement conflicts with present rail freight and future light rail passenger operations. It is therefore necessary to keep the majority of feeder activities north of the railway tracks. The schematic in figure 2, indicates a proposed design that achieves easy access, non-conflicting terminal flows and effective vessel interfacing. Specifically, Bellevue Avenue between 14th and 13th Street would become an east-bound one way, with transit using the near side and kiss-and-ride drop-offs using the far side of the street. Access to the terminal would be by way of a tunnel below the railway tracks. On the south side of the tracks, the proposed LRT station would link into the passenger walk way. On the assumption that the present bus depot would be moved,⁸ some park-and-ride facilities could be provided adjacent to the terminal. Access for the auto users would be located in the vicinity of the LRT terminal. However, since an at grade crossing is required, alternate park-and-ride facilities may have to be found off the site, with free express shuttle service to the terminal. Potential parking lots include open space near the Recreation Centre, and at the 15th Street and 26th Street Highway interchanges. The rather long service headways may require additional stress on providing moderate levels of terminal amenities, and effective feeder-to-ferry interfacing. Every attempt must be made to exploit existing and cost-free visual amenities -- the natural view across the outer harbour towards Point Grey, English Bay and Stanley Park, the Lions' Gate Bridge and Centennial Seawalk. In their entirety, the net result of these ridership policies are also deemed to be small when compared to the Golden Gate System. However, they appear to

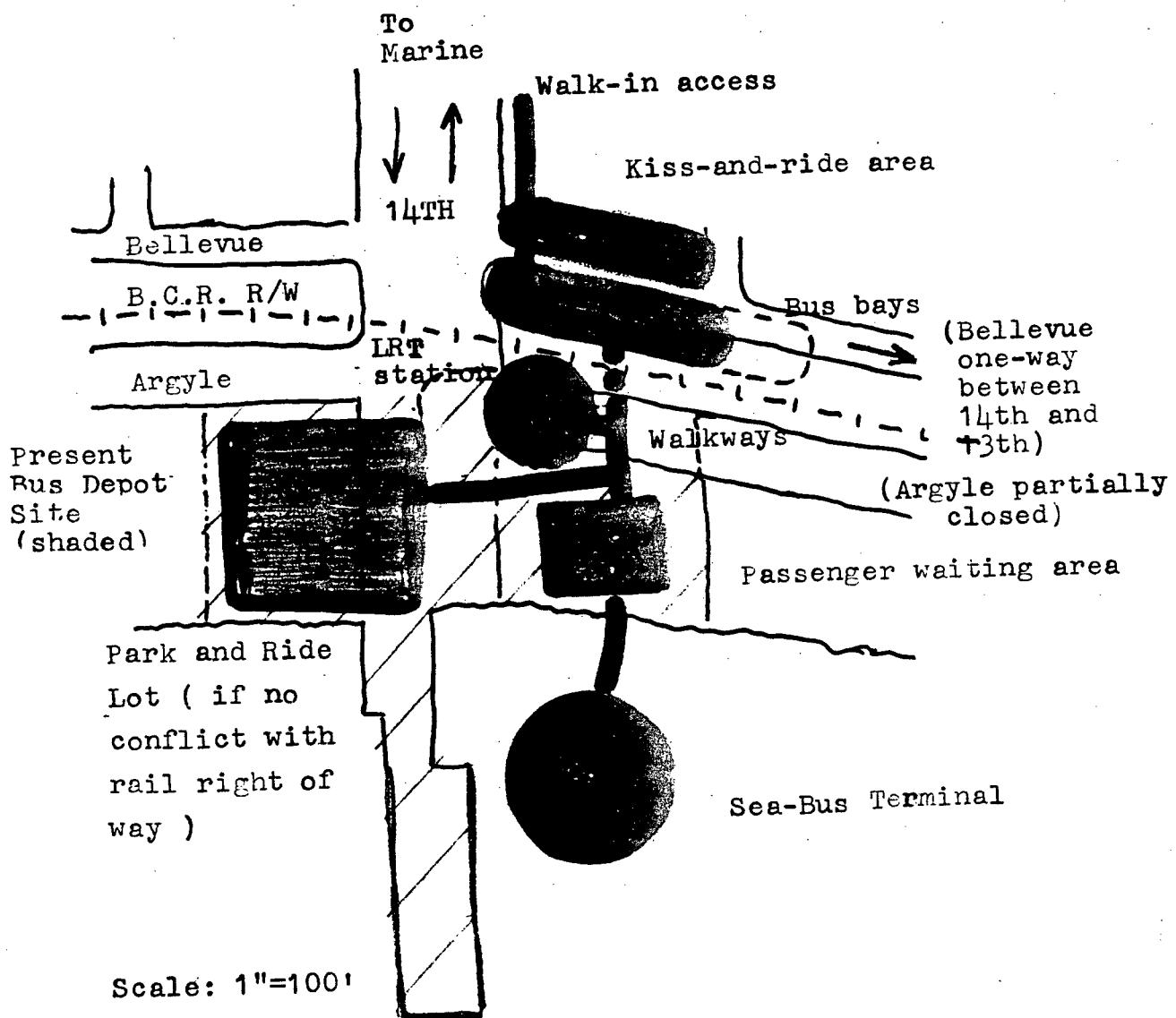


FIGURE 2 West Vancouver Terminal Schematic
Adapted from base map provided by the West Vancouver Department of Development and Planning.

emerge greater in magnitude than those achieved through vessel-oriented policies.

Finally, there is little direct gain in ridership as an outcome of marketing and land use policy. Though it will be important to inform the public of altered bus operation, once regular downtown commuters become familiar with the ferry operation, this customer service will lose effectiveness. Longer term land use changes may result in some ferry patronage increase -- for example, re-zoning land near the terminal area from detached dwellings to low rise multiple dwellings. Return trip patronage could be generated by linking the ferry terminal with fast bus or LRT service to Park Royal, 3/4 of a mile to the east. This policy would have little or no effect on peak hour direction flows, but there probably could be substantial reverse-direction commuting to Park Royal, Capilano 100 and other North Shore centers near Ambleside. Table 1 summarizes the selected policy framework for the West Vancouver Sea-Bus proposal.

Impact of Policy Framework on Ridership

Based upon the assumptions about the extent of the West Vancouver Sea-Bus amenity factor, the mode split increase as a result of the introduction of ferry service was estimated at ten percentage points over the present mode split values. Overall, the ridership increasing potential of the selected policy framework appears to have but one third of the attracting potential of the Golden Gate Ferries (see appendix 1, parts 8 and 9 for details). This mode split rise was translated into a sixty per cent increase in cross-Inlet transit patronage.

Operating Costs: Methods, Comparison and Evaluation

Operating costs for the Sea-Bus system is obtained from a unitized cost

TABLE 1

SUMMARY OF POLICY FRAMEWORK AND IMPACT ON INCREASING RIDERSHIP

POLICY	PART OF FRAMEWORK?	IMPACT
<u>Operations-Oriented</u>		
• System Orientation	n.a.	
• Destination Proximity	yes	high
• Connectivity	yes	medium
• Service Reliability	yes	high
• Preferred Arrival Times	yes	high
• Integrated Transit Feeders	yes	medium
<u>Terminal-Oriented</u>		
• Access Choice		
- transit	yes	medium
- park-and-ride	*	
- park-and-ride hybrid	yes	medium
- kiss-and-ride	yes	high
• Minimize Walking Distance		
- physical design	yes	low
- perceptional devices	no	
- technological systems	no	
• Terminal Flows		
- separated by mode and direction	yes	low
- effective interfacing	yes	low
• Amenities		
- visual	yes	medium
- design	no	
- comfort	no	
- safety	n.a.	
<u>Vessel-Oriented</u>		
• Amenities		
- visual	no	
- design	yes	low
- comfort	yes	low
- safety	n.a.	
- special	no	
<u>Marketing</u>		
• Customer Services		
- inform the public	yes	n.a.
- fare payment schemes	yes	n.a.
• Promotion	no	
<u>Land Use</u>		
• Ferry Served Development	yes	(low)

Key: n.a. = not applicable
 long term impacts are in parentheses

* if adopted, low impact due to space limitation

formula, developed in Appendix 1, part 6. Because a financial statement for the ten months of operation in fiscal 1977 to 1978 is not publicly available, B.C. Hydro's projected budget for 1978-1979 Sea-Bus service was utilized instead.¹⁰ These costs were subdivided into hourly costs, mileage costs and berthing costs. The unit cost figures obtained are \$138.05 per hour, \$8.75 per mile and \$22.53 per sailing.

Operating costs for trans-bridge or feeder bus service, is based on financial and statistical data provided by the District of West Vancouver.¹¹ The unitized operation formula, derived in Appendix 1, part 7, divided costs into hourly costs, mileage costs and peak-hour vehicle cost. The unit costs are estimated as \$10.97 per hour, \$0.45 per mile and \$5.55 per peak hour bus trip.

The operating costs of three alternative scenarios were compared:

- (1) Ferry-only cross-Inlet service;
- (2) Ferry cross-Inlet with limited trans-bridge bus service and
- (3) Equivalent trans-bridge bus service

The resulting operational statistics -- vehicle numbers, route miles and operating time -- for each scenario were developed in Appendix 1, part 11 for use in the operating cost formulas. The assumptions about Sea-Bus service -- frequency, headways and sailings -- are outlined in part 10. Total operating costs are evaluated in parts 12 and 13. Table 2 outlines the operating statistics for each scenario and the current (base) conditions.

In terms of distance, this table indicates that overall peak-hour route miles can be decreased by the substitution of trans-bridge bus trips by ferry crossings. Route distance declines by 137 miles and 81 miles in scenarios one and two respectively, compared to base route miles. The significance lies with the fact that the bus-ferry system is capable of handling more passengers at reduced bus operating miles. More specifically, in

scenario one, the system carries 1.6 times the base peak hour riders, at less than 3/4s of the overall travel distance, with the introduction of the ferry link. On the other hand, bus equivalent service would nearly triple bus mileage, from 487 to 1,282 assuming the current peak-hour ten minute headways continue. (see appendix 1, part 9)

TABLE 2
CASE STUDY OF OPERATING STATISTICS

Alternative	Distance travelled in Miles (Number of vehicles in use)		
	feeder bus	trans-bridge bus	ferry
Base	0 (0)	487 (21)*	0 (0)
Scenario 1	350 (29)	0 (0)	35 (3 in first hour) 21 (2 in second hour)
Scenario 2	230 (18)	176 (14)*	30 (2)
Scenario 3	0 (0)	1 282 (74)*	0 (0)

* totals of buses crossing bridge in CBD direction.

Substituting the operating information into the appropriate formulas (see Appendix 1, parts 12 and 13), the morning peak-hour operating costs for each option are summarized in Table 3. The differences among the operating costs are not very large, especially between the three scenarios. However, the ferry only alternative would have twice the operating cost as the current

base operation. The bus-ferry alternative is less expensive than the ferry only option, but by not more than fifteen per cent. The bus-equivalent scenario appears to be the best alternative from a strictly financial operating viewpoint.¹²

TABLE 3

SUMMARY OF OPERATING COST

Scenario	Operating Cost in dollars
Base	1 025.84
Scenario 1	2 134.61
Scenario 2	1 865.78
Scenario 3	1 796.82

By transforming these operating costs into yearly estimates, a comparison may be performed with the operating cost of an equal capacity bridge. Based upon the calculations in Appendix 2, the table below shows the

TABLE 4

ANNUAL OPERATING COSTS¹³

Alternative	1979 Operating Cost (dollars)
Ferry only	472 158
Ferry with Bus	401 734
Bus Equivalent	353 460
Bridge Equivalent	60 762

yearly expenditures on bridge operation and maintenance would be at a fifth of the cost of the bus equivalent scenario. True operating costs must account

for the right of way usage costs as well. In the case of the ferry only alternative, waterways are free, hence there is no cost. In the second and third alternatives, the cost associated with bridge operations must be passed on to trans-bridge bus operating cost apportioned in terms of the capacity utilized. This is done in a later section.

Evaluation of Capital Costs

The comparison for capital costs is based on the figures and calculations in Appendix 3. Leaving the apportionment of capital expenditures in terms of equivalent capacity requirements for the next section, the total magnitude of the capital expenditures on infrastructure is assessed. For bus associated options, capital cost calculations were limited to acquisition of new buses. In scenarios one and two, no additional buses appear to be needed. For scenario three, a capital expenditure of 2.14 million dollars is envisioned for the expansion of the bus fleet from thirty-four (34) to fifty-four (54). Expenditures for the residential terminal in West Vancouver are based upon costs experienced for the existing North and South Shore Sea-Bus terminal. Such a terminal is estimated to cost close to 16 million dollars (1979). In addition to this are capital costs associated with Sea-Bus purchases. Scenario 1 requires three vessels at a total cost of 12.9 million, and scenario 2 requires two Sea-Buses for a total cost of 8.6 million current dollars. Capital costs for the construction of a bridge at Brockton Point was estimated from a 1970 Swan Wooster-CBA report, to cost near 220 million current dollars.

Comparing the capital costs for these three alternatives, the table below shows that the bus alternative requires the lowest expenditure. The ferry alternatives would cost eleven times more, while the bridge would exceed the bus equivalent alternative by over 100 fold. Amortizing these

capital costs permits them to be related to operating costs on a yearly basis. This is done in the following section.

TABLE 5
MAGNITUDE OF INDIVIDUAL CAPITAL COSTS

Alternative	Capital Costs in 1979 dollars (millions)
Bus equivalent	2.1 ⁴
Ferry options	
Scenario 1	28.7
Scenario 2	24.4
Bridge	218.3

Comparison and Evaluation: Total Costs

The total costs are obtained by amortizing the annual capital costs discussed in the previous section over the lifetime of the infrastructure (or vessel) component (see Appendix 4 for detail calculations), and adding this to the annual operating costs, presented in Table 4. The capital cost is based on apportioning that cost that is associated with the capacity necessary to carry the designated patronage. For the ferry scenarios, the capital costs include the West Vancouver terminal, shore facilities and the required Sea-Bus vessels. No attempt was made to allocate the benefits or costs of capacity freed up on the bridge as a result of scenarios one or two. It is assumed that there is enough backlog traffic, as shown in figure 1 of Chapter three, to keep the bridge loaded during the two hour peak period of Sea-Bus operation. No capital costs related to the use of streets by the feeder buses or use of the South Shore terminal by the West Vancouver Sea-Bus are included as they are sunk costs. Annual operating cost of the

ferry with bus and bus equivalent options include the bridge operating cost, apportioned in the same manner as capital costs. The final annual capital and annual operating costs, plus the total cost is summarized in Table 6 below.

TABLE 6
COMPARISON OF TOTAL COSTS

Alternative	Costs: (million \$)		
	Capital	Operating	TOTAL
Ferry only	1.25	0.47	1.72
Ferry with buses	1.40	0.43	1.83
Bus equivalent	0.81	0.41	1.22

Based upon the figures in this table, the bus equivalent alternative is the most cost effective method of transporting the designated peak-period commuters. Of the two ferry alternatives, the first is more cost effective than the second scenario -- costing 1.4 times as much as the bus equivalent system and just ten per cent less than the ferry system with partial trans-bridge bus operation. Resting upon economic factors alone, the bus equivalent alternative is more feasible than a ferry transit proposal. However, this result should be observed with caution. The relative magnitudes of total costs may change if a different interest rate is utilized in calculating the capital recovery factor. Also, it is not entirely clear if the bus system, with the limited level of amenities when compared with the ferry, can indeed achieve the ridership level of a ferry transit system.

Evaluation of Non-Quantifiable Aspects

Aside from the economic evaluation, a number of non-quantifiable items

are associated with the ferry option as an alternative to bridges and buses for over-the-water transportation. In the first instance, West Vancouver commuters -- both car and transit commuters -- have no other convenient route by which to reach the South Shore than by the Lions' Gate Bridge. The only other non-interrupted option, the Second Narrows Bridge, would add about nine miles to the one way West Vancouver to Vancouver CBD trip. The adoption of a Sea-Bus system would give the West Vancouver commuter a convenient and fast transit contingency system.

Secondly, the ferry system would insure adequate accessibility to and from West Vancouver and points on the South Shore and Lower Mainland. The Lions' Gate Bridge is an aging structure, that may require closure and replacement some time in the future. Secondly, an accident such as a ship grounding or sea-plane crash into an integral part of the structural component or a natural disaster such as an earthquake, could reduce the number of usable lanes or knock the span out entirely. The institution of a Sea-Bus in advance of any such eventualities, would guarantee the continued, convenient, accessibility and mobility standards of West Vancouver residents.

A third item that concerns physical access is the proposed structural improvement of the Lions' Gate Bridge. There exists the potential of long closures as a result of the B.C. Department of Highways' bridge deck replacement project. Since re-decking is not a well established construction technique, engineering, technical or structural problems may close the bridge for prolonged periods of time. There is the remote chance of permanent closure. A West Vancouver Sea-Bus could help to relieve transportation problems during any planned or unplanned bridge closures.

The fourth item is the flexibility and reliability of the ferry transit

concept. The system can be easily sold if it is found not to succeed in West Vancouver. The floating terminals can be cut loose, relocated or sold along with the Sea-Bus ferries. Once in place, bridges do not have this relocation potential, nor do they have a resale value other than as metal scrap. Sea-Bus can be sold as a functional, quickly implementable, over-the-water infrastructure. As a result of the system's flexibility, policy makers and policy making has a broader scope. Policy makers are not necessarily bound to the ferry system once it is implemented. Policy and operating flexibility can directly contribute to system reliability. Ferries are not constrained by the traffic stream, thus system wide reliability due to better schedule adherence during the peak period is attainable. Furthermore, ferry transit is independent of the road network and buses become independent of CBD oriented arterials. Not only is the ferry independent of the vehicular traffic streams but it does not require any over-the-water infrastructure. Though the creation of separate transit-only infrastructure does remove transit from the over-the-water traffic stream, reliability is not necessarily guaranteed. For instance, a transit-only tunnel, such as the BART Tube, can easily be closed in busy harbours due to anchor dragging or accidental fires. Furthermore, in areas where bridge icing and snowfall is a greater problem than fog, ferries have the inherent advantage of better schedule reliability than buses. Unlike the bus, the ferry route is only constrained by two stops that are the portals of the system. Finally, the sailing route is flexible in allowing the most direct routing and permitting circumnavigation of most marine obstructions.

The fifth item revolves around the need for added physical cross-Inlet capacity. Just the bridge and ferry alternatives have the capability of achieving this goal and the policy to increase ferry, or for that matter,

transit ridership. The advantage of a bridge is not only the higher physical cross-water capacity, but if transit-only lanes are provided, less infrastructure is required due to the higher utilization of capacity by buses than by a stream of cars. Ferry systems need no over-the-water infrastructure to have an exclusive right of way.

The sixth issue arises out of the social and environmental aspects. Bridge construction can result in permanent damage to the ecology of the shore lines near the spanning towers. The often massive access infrastructure may do further environmental damage immediately near the bridge and in the vicinity of its path away from the bridge. Shore facilities for the ferry are limited to dolphins that moor the floating terminal. Extensive access facilities would be unnecessary as access modes could utilize existing roads. New highways and roads associated with bridge construction lead to various social impacts. Neighbourhood severance, visual intrusion and the concentration of noise and fumes have a major disruptive community-wide effect. When constructed in built-up areas, they tend to become barriers to pedestrian and vehicular mobility.

As the seventh item, the ferry concept provides the commuter with a wider range of access and destination opportunities than conventional bus transit. Transit modes and access choice to the Ambleside ferry terminal ranges from walk-in to LRT to park-and-ride. Secondly, being a time transfer focal point, destination opportunities and the travel convenience of the average transit commuter can be enhanced.

Finally, the ferry option provides a major planning advantage. System capacity can be planned to coincide with transit demand associated with the population growth of the community. In an opposite respect, the ferry capacity that is provided can be tailored to meet the Municipal policy of slow growth.

In summary, the ferry option has a number of clear qualitative advantages over bridging options and moderately important operating benefits over equivalent bus service. A ferry to West Vancouver would increase accessibility and mobility, allow for greater policy and operating flexibility and enhance the overall network reliability, with minimum social and environmental impacts.

Findings

The shortness of the West Vancouver ferry route, necessitated a policy framework that accentuates terminal-oriented and operation-oriented policies. Terminal-oriented policies emphasize the provision of access choice and effective terminal flows -- both pedestrian and vehicular. Operation-oriented policies stress integration of the West Vancouver Municipal bus routes with a ferry system, the continuation of the reliable and friendly service standards, and meeting the preferred morning peak period arrival times to the Vancouver CBD. Based upon the San Francisco experience, the ridership increasing ability of the selected policy framework is estimated at sixty percent -- from 1,500 to about 2,500 over-the-water transit passengers in the morning peak period.

Most notable are the findings of the case study for ferry service to West Vancouver. First, the economic feasibility of the two ferry alternatives -- ferry only or ferry with limited trans-bridge bus services -- was compared with an equivalent bridge-bus system for the same patronage level. Secondly, in contrasting the annual total costs, the apportioned capital costs plus operating costs, the ferry option was found to be 1.4 times as costly as the bus equivalent system. Thirdly, in assessing the various non-quantifiable aspects of the three alternatives, the ferry-only option appears to have some distinct advantages over bridge building or over

bus-bridge alternatives. These include various social and environmental benefits, policy flexibility and alternate access advantages for West Vancouver citizens. In the final analysis, the ferry system is not the most desirable option from an economic basis alone. However, the qualitative benefits of the ferry tend to outweigh the larger economic costs. Hence, within the limitation of this case study, it is proper to conclude that a ferry transit system can be considered as a viable transportation option for the District of West Vancouver.

FOOTNOTES

¹Census Canada, 1976.

²Adrian Kopystynski, Some Findings on West Vancouver Transit Use (Based on the 1978 Citizen Survey) (West Vancouver, B.C.: Department of Planning, [1978]), pp. 4 - 6.

³Conversation with Mr. C. Spratt, Sea-Bus General Manager, on March 13, 1979..

⁴Conversation with Mr. T. Lester, West Vancouver Municipal Manager, on March 27, 1979.

⁵Corporation of the District of West Vancouver, "Mayor's Memorandum to Council re.: North Shore Traffic Study". May 26, 1978, p. 2.

⁶Conversation with Mr. L. Ward, Assistant General Manager of the Urban Transit Authority (Vancouver), on February 21, 1979.

⁷See appendix 1 part 8.

⁸Municipal Transportation Department, (Review of the) Transit Task Force Report (West Vancouver, B.C.: Municipal Transportation Department, 1978), pp. 16 - 25.

⁹See appendix 1 part 8.

¹⁰Urban Transit Authority, UTA Briefing Manual ([Victoria], [1978]), pp. 102 - 104.

¹¹Corporation of the District of West Vancouver, Financial Statement (West Vancouver, B.C.: Corporation of the District of West Vancouver, 1978), pp. 8,10,21.

¹²Operating costs have excluded correction for collected fares.

¹³See appendix 2 part 2 for modification of operating costs when total costs are discussed in the text.

CHAPTER SIX FINAL FINDINGS, RECOMMENDATIONS AND CONCLUSIONSFindings

The specific findings of this thesis rest upon the outcome of the West Vancouver ferry case study. Assessing the total costs of both operational and capital requirements, the ferry option is not as economical as a bus system option capable of handling an equivalent patronage level. Therefore, the ferry alternative cannot be advocated by policy makers on the basis of cost-effective passenger transport. These added costs, however, may be fully justified by non-economic, non-quantifiable social, environmental and planning advantages directly associated with the implementation of a ferry transit system. The ferry transit concept should be considered as a serious transportation option in West Vancouver.

Recommendation

Based upon a goal to increase the proportion of transit cross-Inlet trips from West Vancouver, it is recommended that the following policies be implemented. First, a future crossing serving West Vancouver ought to be a ferry transit link. Second, as one policy in a series that make up the policy framework associated with the commitment to ferry transit, the West Vancouver terminal should be located in Ambleside, where the majority of West Vancouver commuters reside. Third, the Municipal transit system must be integrated with the ferry in terms of the fare and the departure/arrival schedule. Fourth, the reliable, convenient and friendly transit service standards of the present Blue Bus system should be maintained. Fifth, extra emphasis should be placed on providing safe, easy and convenient access opportunities, through proper terminal complex design. Sixth, access choices should include bus transit, park-and-ride (preferably on the site if space

and rail traffic permits), plus car, taxi and para-transit drop-off facilities. Seventh, every effort should be made to exploit natural amenities in the design of access ways, waiting and boarding areas in the terminal. Eighth, a limited level of vessel amenity -- soft chairs, conversation areas, plus coffee, snack and cocktail services -- should be incorporated by policy. Ninth, it is particularly important to advertise the system and inform the commuting public in West Vancouver, how to reach and use the proposed system once it is operational. And finally, a long term policy of land use should emphasize the provision of such attractions in the lower Ambleside area that would be capable of inducing ridership on the morning return trips from CBD Vancouver.

Conclusion

In the final overview, the ferry transit concept presents itself as a viable transportation option. The burden of the higher economic costs may become mitigated with time and/or with timing. One near certainty is that fuel costs can be assumed to continue their rapid escalation. In this respect, higher capacity can more effectively transport commuters, especially at times when crisis proportions are reached. This cost escalation will also precipitate a mode shift from car to transit use. Coupled with the growth in population, there exists the potential for the development of a sizable transit market for ferry service in West Vancouver.

One set of conditions that will not change in time are the inherent qualities of the ferry mode. Social, environmental and planning advantages will continue to be strong factors favouring this option. The requirement for a convenient, contingency access mode to and from West Vancouver will also be a permanent concern. The ferry option can mirror the trend in society to more leisure time. The amenity of being on the water, fresh air,

no driving frustrations and the ability to travel to work without the need to adjust personal schedules for bridge overloading, cater to this trend. Furthermore, the expansion to a high capacity system, with volumes approaching those of a bridge can be achieved without the negative environmental ramifications associated with bridge infrastructure. Finally, a great deal of policy, operating and planning flexibility are available to the policy maker and the transportation planner.

The West Vancouver situation is not unlike some other residential communities in metropolitan areas upon navigable waters. Certainly, the typical peak-hour, peak-direction and peak-location transportation problems, exist to some extent in all of them. Whether a ferry option is suitable for all Canadian and U.S. cities similar in nature to West Vancouver, cannot be ascertained. The clear indication is, however, that the ferry concept does have a potentially significant role to play -- planners should consider ferry transit as a serious transit option. But only time and wise planning can reveal the magnitude of ferry transit's role on the urban scene in the United States and Canada.

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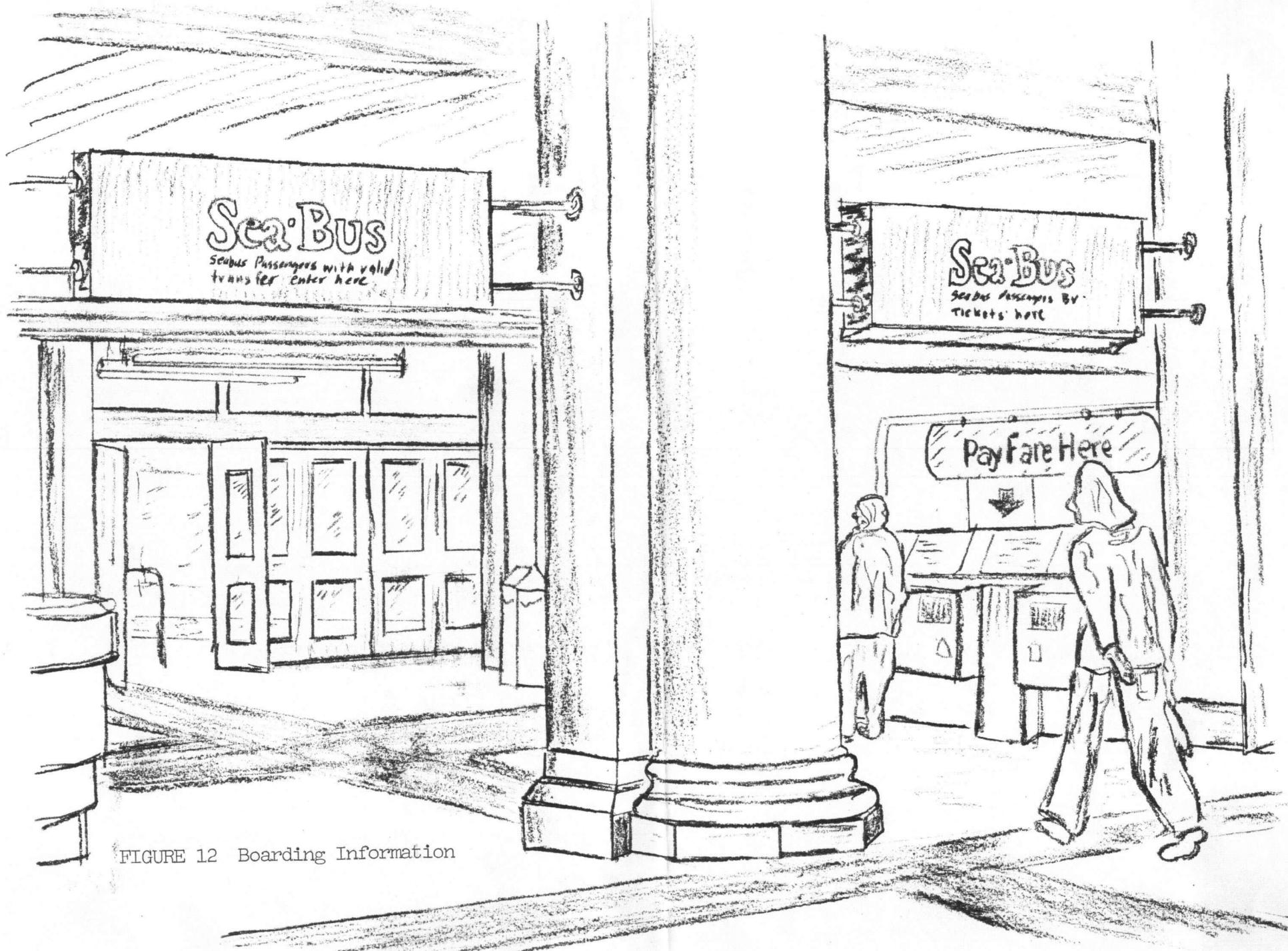


FIGURE 12 Boarding Information

How to win at the game of bridge.

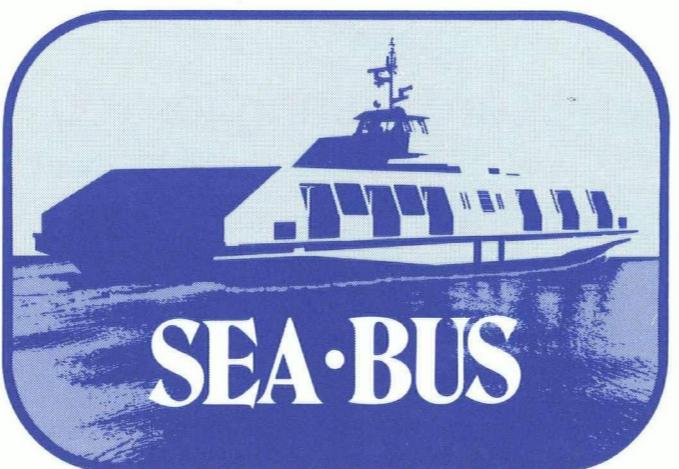
with the Sea-Bus system. Generally, the neighbourhoods between Lynn Creek and Mosquito Creek in the District and City of North Vancouver will be served with bus services that are destined for the Lonsdale Quay.

For those who need them in Downtown Vancouver, two shuttle bus routes will be introduced. Connecting passengers will be able to choose a Granville Mall service or one that takes them to Burrard Street and the "Golden Triangle".

Detailed route and schedule information for all connecting bus services can be obtained by contacting:

B.C. Hydro Transportation
850 S.W. Marine
Vancouver, B.C. V6P 5Z1

The Sea-Bus really goes to town.



SEA•BUS



Province of British Columbia
Ministry of Municipal Affairs and Housing
The Honourable Hugh A. Curtis, Minister

Take the Sea-Bus.



1 One bus ticket does it all



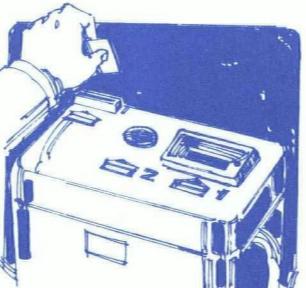
can travel from home to a destination in Vancouver via the transit system.

2 Ask for a transfer



Transferring to the Sea-Bus is just like changing buses. A transfer/fare receipt issued by your bus driver is your fare for the Sea-Bus and connecting buses. Be sure to ask your bus driver for a transfer when paying your bus fare, and retain the transfer for the connecting ferry ride and bus trip.

3 Or buy your ticket right at the terminal



Should you live or work close to one of the ferry terminals, or decide to get a ride to the terminal, ticket machines are located at each station. A self-service fare system is being employed. The passenger will be responsible for depositing the exact fare:
35¢ Adults
15¢ Students and Seniors (with valid cards)
10¢ Children

After depositing the fare in coins, the passenger then

pushes a green button on the top of the ticket machine, and then takes the transfer issued from the slot. This transfer, like the one issued by a bus driver, is valid for the ferry ride and connecting buses.

Each passenger must have a valid transfer for inspection in the terminals or on the ferry.

6 All aboard



As you walk from the bus loop or the escalator, signs will direct you to the departure lounges. Once inside the floating terminal a directional sign will indicate which ferry will be leaving next. After passing through the turnstiles which only control the number of passengers entering each ferry, you will be in the departure lounge. When the ferry is ready for loading, entrance ramps will automatically be lowered into place and the departure lounge doors will open. Passengers are expected to enter quickly and take a seat. Departure will follow soon after.

7 In minutes you're there



The Sea-Bus system connects the North Shore and Downtown Vancouver. The Lonsdale Quay is the north shore terminal of the Sea-Bus. It is situated just off Esplanade at the foot of Lonsdale. A bus loop, a temporary kiss'n ride drop-off area on Esplanade and the floating ferry terminal are linked together by covered pedestrian walkways.

At the Granville Waterfront Station an escalator will take passengers from the floating terminal to an enclosed walkway 26 feet above the railway tracks and into the Station on Cordova Street at Granville.

Later this fall, when the stairway linking the Station concourse with Granville Square is completed, the Station, walkway and floating terminal will become an extension to the Granville Mall pedestrian precinct.

5 Laugh at the rain



Your walk between bus and ferry at both the Lonsdale Quay and Granville Waterfront Station is protected from the elements. The bus loop at the Lonsdale Quay is covered with a canopy, as is the sidewalk leading to the floating terminal. The Granville Waterfront Station is completely enclosed. Passengers are protected from weather arriving and leaving at both sides.

The ferries are powered by 4 diesel engines that permit each ferry to cross the Inlet at a speed of 13.5 knots. On weekdays the ferries will begin service at 6:15 a.m. and operate every 15 minutes until 7 p.m. From 7 p.m. until midnight there will be a sailing every 30 minutes. Saturdays the service will begin at 6:30 in morning and run every 30 minutes until noon. Between noon and 6 p.m. service is increased to 15 minutes. Ferry sailings revert to half hourly from 6 p.m. until midnight. Half hourly service is offered on Sundays and holidays between 8:30 a.m. and 11:30 p.m.

8 Buses are waiting for you



At both the Lonsdale Quay and the Granville Waterfront Station there will be buses to take you to your destination. The arrival and departure of these buses will be co-ordinated with ferry sailing times.

The North Shore bus services have been completely overhauled in conjunction

SEA·BUS

HARBOUR RIDE

FIGURE 17



The first of its kind anywhere in the world, the people-mover ferries are an all-aluminum, double-ended, catamaran design. Each has a 400-passenger seating capacity with a full system capacity of 1600 passengers per hour across Vancouver's busy harbour. Six sets of double doors permit rapid boarding. **Vessel Statistics:** length 112' 6", width 41' 6", depth of main deck 11' 6 3/4", draft loaded 6' 8", engines 4-12V-71NA Detroit diesels with 4 x 400 brake horsepower output, max. speed 15 knots, service speed 11.50 knots, auxiliary power

Sunday Sailors Sunday and holiday bus passes are also available, valid for unlimited holiday riding on Seabus and B.C. Hydro Transit Buses. They are not sold in Seabus termini but can be obtained from any bus operator either when using a bus to Seabus or from the connecting buses waiting outside the Seabus terminus: 75¢ Adult, 25¢ Child. Exact cash fare is required in the fare boxes. Bus operators do not carry change.

Groups No group fare reductions are offered, nor are Seabus operations available for charter. Special arrangements for group travel can be made. Telephone 324-1101

Refunds Ticket machines will accept overpayment in coins if the exact fare is not available but no refunds will be made except where coin is lost in the machines due to a malfunction. Refunds for such a loss will be made on application to B.C. Hydro Transportation, 850 S.W. Marine Drive, Vancouver, B.C.

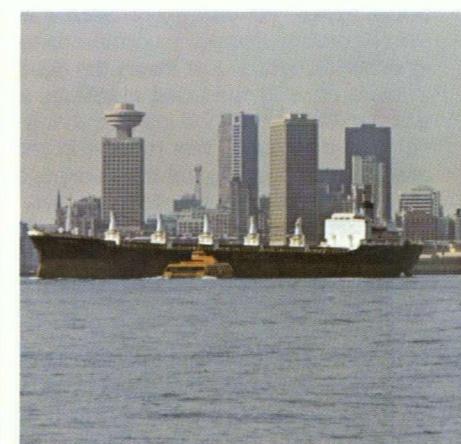
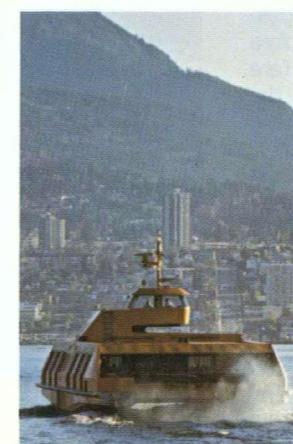
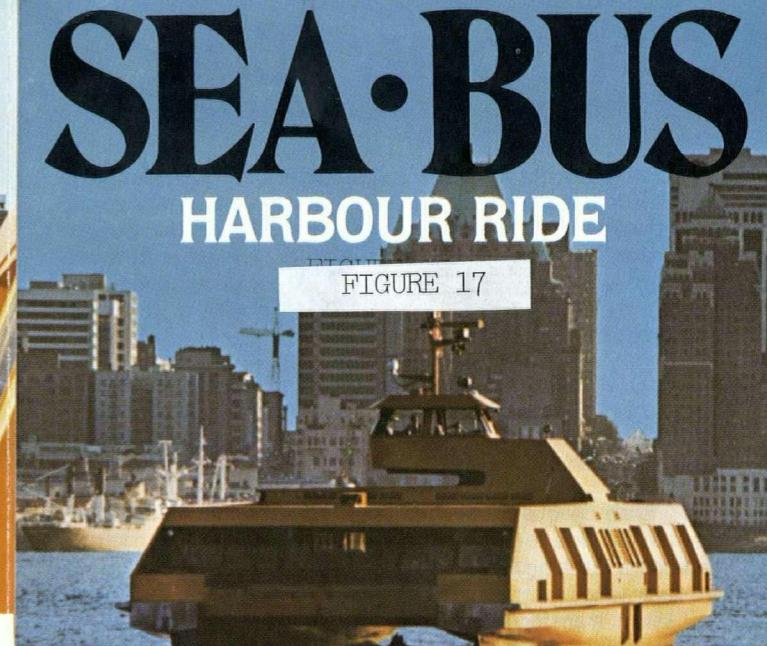
Lost at Sea & other Seafare The lost property office is located at 696 Cambie Street, Vancouver, telephone 663-2133. Wheeled vehicles such as large baby carriages and bicycles cannot be carried on Seabus as the only access to and from downtown is via long escalators. Wheelchair users with escort can be accommodated but contact of Seabus at 986-1501 for arrangements is recommended. Pets are not permitted on Seabus. Smoking is not permitted on the ferries or carpeted walkways.



The information booth in Granville Waterfront Station, adjacent to the fare machines, carries timetables for routes and schedules of connecting buses; and nearby wall maps show connecting bus routes and orientation to downtown points of interest.



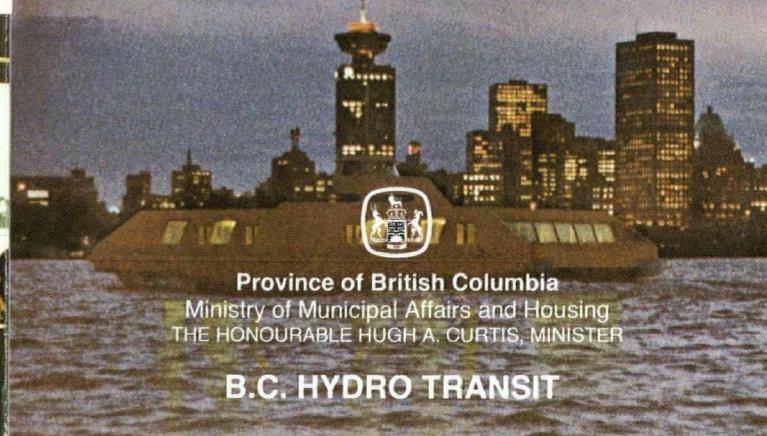
2 x 120KW generators (Detroit diesels). • Each terminus is of a floating E shape design with two berths each. Maintenance and overhaul berths are at Lonsdale Quay. **Terminus Statistics:** length 260', width 262', berth length 117', height above main deck 20', hull depth 17', weight 9,130 long tons, basic float composition 11" concrete with 86 cells & steel piling & wood fendering. Waterside of Granville Waterfront Station is shown.



Early morning view against North Vancouver and mountains. • Seabus manoeuvres easily around giant deep sea vessel. • Evening crossings offer romantic sunsets over Vancouver skyline.



Transit Information 324-3211



Province of British Columbia
Ministry of Municipal Affairs and Housing
THE HONOURABLE HUGH A. CURTIS, MINISTER

B.C. HYDRO TRANSIT

Harbour Ride

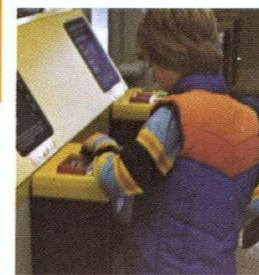
Vancouver's unique experience



See the sights Vancouver is famous for while you ride on the most unique ferry system in the world — a dramatic scenic panorama of mountains, ocean and city skyline. Seabus provides a quick and convenient way of travelling between downtown and the North Shore. By day ... a pleasant harbour crossing. By night ... a romantic view. Either way, a 12 minute adventure not-to-be-missed.

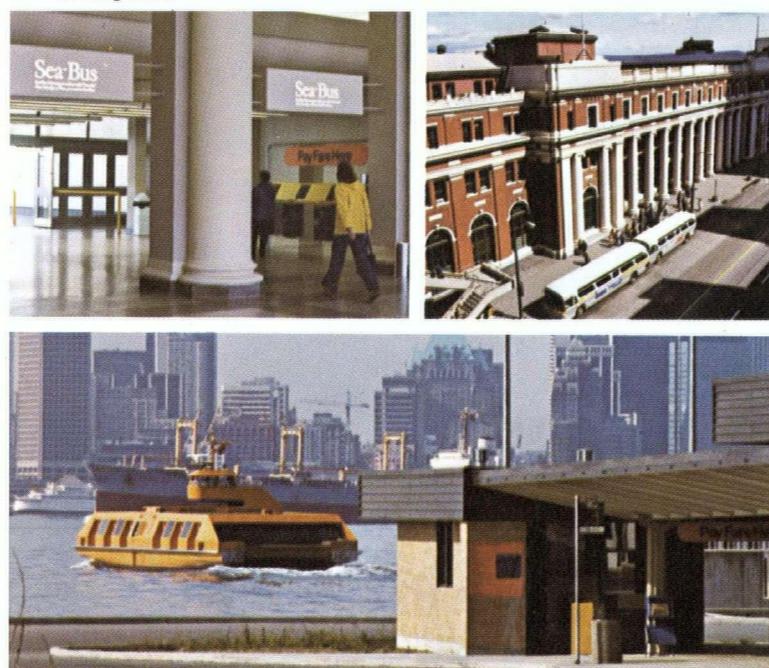
Sailings Day sailings: every 15 minutes. Evenings, Sundays, holidays and Saturday mornings: every 30 minutes. If you're a visitor, the best time to travel is before 3 p.m. or after 6 p.m. to avoid heavy commuter traffic.

Fares Each Seabus passenger must have an individual ticket. Fares are identical to those of the bus system in Greater Vancouver. Passengers reaching Seabus by transit may ride at no extra charge with their valid bus transfer/fare receipt. Other passengers must purchase a transfer/fare receipt at the automatic self-service ticket machines clearly signed "Pay Fare Here" at each terminus location. **The exact fare payment is required in coins — 35¢ Adult, 10¢ Child.** No change is available and pennies are not accepted in the machines.



Transfers One-way Seabus transfer/fare receipts are valid for transfer to buses at the Lonsdale Quay or in downtown Vancouver, north of Duns- muir within one hour of the issue time printed on the receipt.

Fare machines in Granville Waterfront Station, leading to skywalk and Seabus berths. • Exterior facade shows convenience of bus connections in downtown Vancouver. • View from Lonsdale Quay in North Vancouver, showing bus bays and fare machine area in foreground.



The two 400-passenger vessels are named Burrard Beaver and Burrard Otter after earlier steam-powered ships that operated on the West Coast. Seabus vessels are exceptionally manoeuvrable, with four combined propulsion and steering units, one at each end of both hulls, capable of rotating 360 degrees. The four independent engines are controlled

from the bridge and a Master, a Mate and two Attendants comprise each crew. The ferries cover the 2-mile (3.2 km) crossing distance in 12 minutes. • View with North Shore mountains, and pleasure craft in foreground.

Inspections Random inspections are made within the areas of the ferry termini marked as "Fare Paid Zones". Do not enter these clearly marked zones without holding a valid transfer/fare receipt.

Round Trips Round trips on Seabus are possible by paying double the normal one-way fare at either terminus. Just insert the double fare in exact coins in the ticket machines and the transfer/fare receipt will indicate that a double fare has been paid. This round-trip receipt is good for one hour. Round-trip receipts are not valid for transfer to connecting buses. Please note that because of safety regulations, all round-trip passengers are required to disembark at the terminus and re-enter the turnstiles for the return trip.

Map of Burrard Inlet shows the locations of Granville Waterfront Station and Lonsdale Quay in Vancouver's harbour. The entrance to Granville Waterfront Station is on Cordova Street, at the north end of Granville Street in downtown Vancouver. The arrows also show entrances from Granville Square to the west, and a parking lot to the east. The building contains public telephones and washrooms. The P symbols locate automobile parking facilities. Visitor attractions in Gastown and Chinatown are within reasonable walking distances.

Lonsdale Quay is at the foot of one of North Vancouver's major streets. The terminus for bus connections is adjacent to Seabus berths and an information booth for north shore attractions is located at the fare machines. There are a number of restaurants and small stores within walking distances from the Quay. Timetables for connecting buses are at both Seabus termini.



KOPYSTYNSKI, ADRIAN DANIEL

FIGURE 12: BOARDING INFORMATION

FIGURE 16: HOW TO WIN AT THE GAME OF BRIDGE

FIGURE 17: SEA-BUS HARBOUR RIDE

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Appendix 1

1. Physical Data

West Vancouver ferry route length	3.5 n. miles (4 st. miles)
Vessel speed	14 knots
Crossing time	15 minutes

2. Travel Time Data

All data is based upon the centroid of the West Vancouver Census Tracts. (see figure a-1)

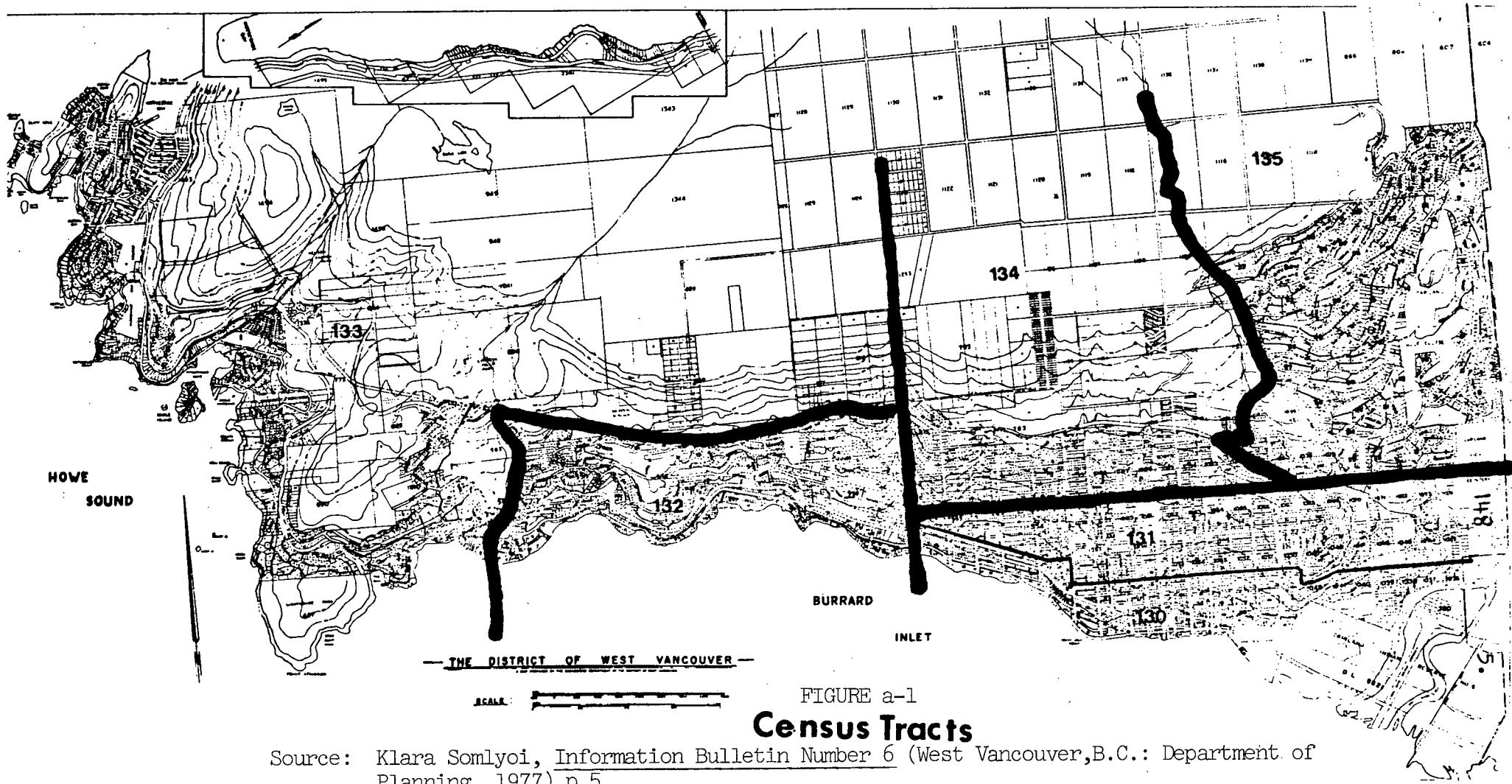
Tract	Average travel time to Vancouver		
	Car	Bus	Ferry-bus
130/131	20	25	23
132	25	33	28
133	35	50	45
134	17	20	19
135	20	25	28

See isochrone map in figure a-2.

3. Population/workforce Statistics

Information from Census Canada, 1976:

Tract	Population	Labour Force	CBD Bound
130/131	15 463	7 455	3 578
132	4 093	2 485	1 193
133	6 370	3 840	1 363
134	5 263	3 815	1 831
135	6 200	3 795	1 822
Total	37 389	21 390	9 787



Source: Klara Somlyoi, Information Bulletin Number 6 (West Vancouver, B.C.: Department of Planning, 1977), p.5.

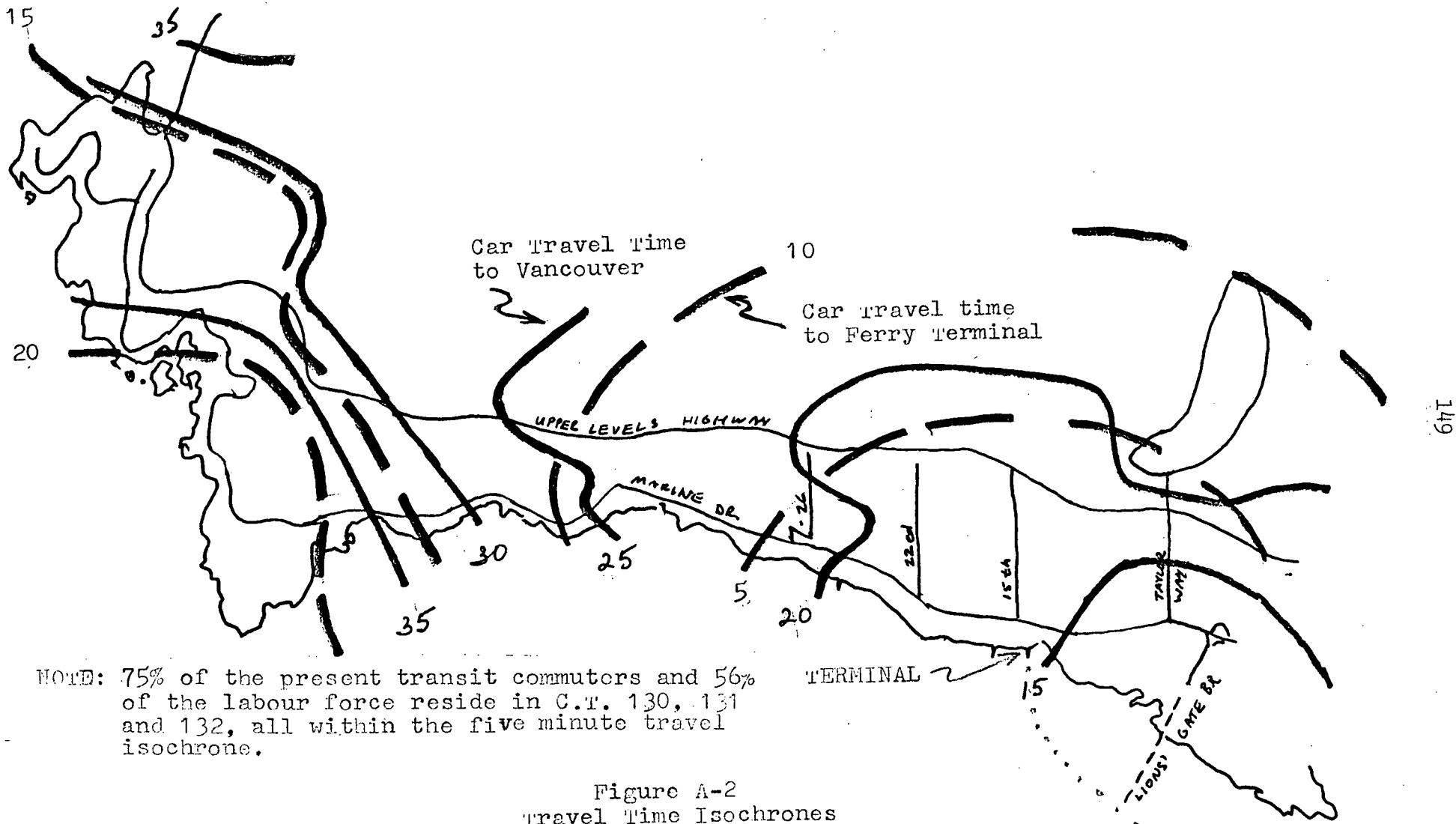


Figure A-2
Travel Time Isochrones

Data Source: Greater Vancouver Regional District
West Vancouver Municipal Transportation

4. Mode Split/Bus Patronage

Mode split values are based upon West Vancouver Citizen Questionnaire, 1977.

Tract	% Mode Split	Patrons
130/131	25	895 (60% of all commuters)
132	7	84
133	11	150
134	14	256
135	8	146
Total		1 531

5. Patronage Cross-check

The predicted number of trans-bridge patronage obtained in 4 was compared to actual counts collected by West Vancouver Municipal Transit. The average peak-hour ridership for the period between February 26 and March 16, 1979 was 1 581. The mode split from the survey appears accurate.

6. Derivation of Sea-Bus Operating Costs

The 1978-79 Burrard Inlet Ferry system budget that appears on pages 102-4 of the Urban Transit Authority Briefing Manual¹, is the bases of this operating cost unit model. Costs were aggregated as follows:

Hourly Costs

Ferry wages	261 725
Terminal wages	423 042
Associated wages	43 407
Benefits	178 587
Total	906 761

Mile Costs

Fuel	103 343
Maintenance	8 823
Ferry Maintenance	226 397
Total	338 563

Berthing Cost

Terminal Maintenance	71	315
Administration	328	480
Other	35	905
Total	435	700

Costs are unitized on the basis of scheduled operations. The Total number of yearly operating hours per boat is 6 570 hours, the yearly mileage is 38 688 miles and the total number of sailings is 19 344.

Hence the unit costs are:

138.05 per hour
8.75 per mile
22.53 per sailing

Unit operating cost is expressed by the formula:

$$O.C. = 138.05 \text{ (hours)} + 8.75 \text{ (miles)} + 22.53 \text{ (sailings)}$$

7. Derivation of the West Vancouver Bus Operating Costs

The operating costs for the West Vancouver Municipal Transportation System were obtained from page 21 of the 1977 West Vancouver Financial Statement². Costs are aggregated as follows:

Hourly Costs

Wages	724	694
Indirect wages	230	529
Uniforms	8	352
Total	963	575

Mile Costs

Repair, Maintenance	239	887
Fuel	98	864
Tires	21	511
Other	24	488
Total	384	750

Peak-hour Vehicles

Administrative Salaries	37	302
Administrative Costs	36	158
Total	73	460

Operating statistics reveal a total of 87 845 yearly driver-hours, a yearly system mileage of 858 000 and the total number of peak-hour trans-bridge buses is 13 260 a year. The unit costs are:

10.97	per hour
0.448	per mile
5.55	per peak-hour bus

So:

$$O.C.' = 10.97 \text{ (hours)} + 0.448 \text{ (miles)} + 5.55 \text{ (buses)}$$

8. Ferry Mode Split Derivation

The mode split levels for each Census Tract is based upon a comparison with the estimated mode split values developed in San Francisco³. The basic assumption is that a thirty percentage point increase in patronage could be obtained for a ferry system if the bus and ferry travel times are equal. This is a direct effect of the "Amenity Factor". The source of this amenity factor is estimated roughly as: seven percentage points for the vessel technology, twelve percentage points for the on-board amenities and the remaining eleven are for terminal amenities.

Through a direct comparison with the San Francisco system, the West Vancouver ferry mode split was assessed as follows:

Technological amenity	-- a half of San Francisco	(3)
Terminal amenities	-- a third of San Francisco	(4)
On-board amenities	-- a quarter of San Francisco	(3)

Mode split increase in West Vancouver is ten percentage points.

9. Projected Ferry Ridership

Tract	Mode Split	Ferry Patrons
130/131	35 %	1 250
132	17 %	203
133	21 %	286
134	24 %	440
135	18 %	328
Total		2 507

10. Service, Frequency and Headway

a. Period of service

The 2 507 passengers would ordinarily travel to the CBD sometimes during the 2-1/2 to 3 hour peak period. Basically, a person must choose an earlier or later departure time because of the capacity limitation of the bus system and the peak-loading condition that has broadened the peak period. With the introduction of a ferry system, the passengers will be able to travel closer to their desired travel time. Service is developed upon the assumption that the ferry system will serve the passengers ordinarily traveling during the present peak period in a two hour period.

b. Vessel Requirements

The number of sailings required to transport the 2 507 passengers is $2\ 507/400 = 5$ sailings. Assuming the distribution of passengers will be sixty per cent in the first hour and forty per cent in the second hour, then the number of vessels required (N) is found by the expression:

$$N = \frac{\text{Cycle time}}{\text{Headway}}$$

The cycle time is twice the crossing time plus berthing:

$$= 15 + 15 + 5 + 5$$

$$= 40 \text{ minutes}$$

The headway is just the time between consecutive sailings. The vessel requirements for various headways, the optimum headway and maximum frequency of service are presented in the table following.

N	h	h_{best}	f_{max}
4	10	10	6
3	15	14	4
2	20		
2	30	20	3
1	40		
1	60	40	1

c. Service Requirements

Based upon the assumed passenger distribution, the number of passengers and sailings per period is:

7 - 8 am	1 500 pax	4 sailings
8 - 9 am	1 007	3

Hence, four sailings per hour in the first hour, at fifteen minute headways, with a ten minute layover in West Vancouver and a five minute layover in Vancouver are required. This translates into $45/15 = 3$ vessels. In the second hour, twenty minute headways, with five minute layovers at each end, would require $40/20 = 2$ ferry vessels. The time-space diagram (figure A-3) illustrates the operating sequence.

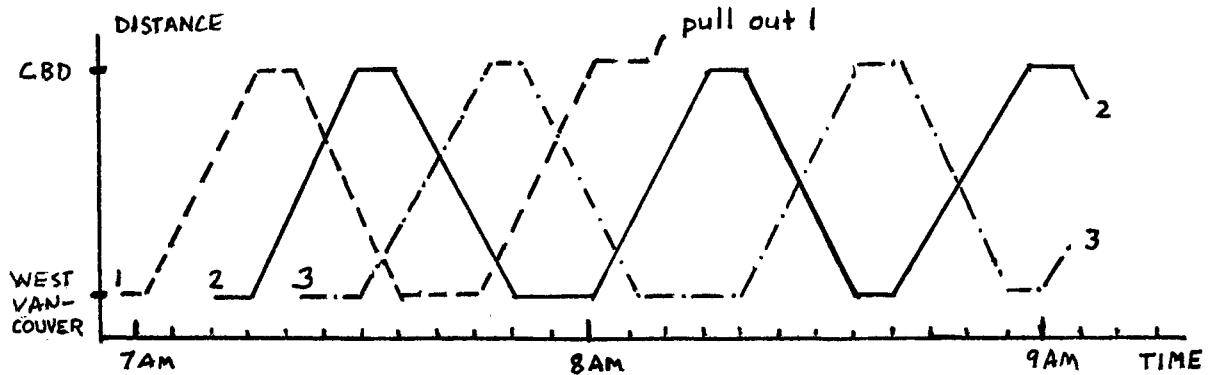


Figure A-3. Time-space diagram for ferry operation

Notice that the system has a reserve capacity of 293 passengers.

11. Operation Scenarios

Scenario 1 Ferry Only Service

- no trans-bridge bus service
- buses used as Sea-Bus feeders
- half of passengers will use park-and-ride or kiss-and-ride facilities; bus ridership is 1 254
- ferry and bus schedules are integrated

Route calculations

feeder service:⁴

First Hour:

Tract	pax	h	N*	Distance**
130/131	375	15	4	40
132	62	15	2	32
133	85	15	4	64
134	132	15	3	28
135	98	15	4	36

Second Hour:

Tract	pax	h	N	Distance
130/131	250	20	2	30
132	40	20	2	24
133	58	20	3	48
134	88	20	2	21
135	66	20	3	27

Totals:

Bus time: 2 hours

Bus distance: 350 miles

Number of buses: 29

Notes:

$${}^*N = \left\{ \begin{array}{l} \frac{\text{cycle time}}{\text{headway}} \\ \qquad \qquad \qquad (= N_1) \\ \frac{\text{pax}}{51} \times \frac{\text{cycle time}}{60} \qquad \qquad (= N_2) \end{array} \right\} \text{ whichever one is larger}$$

$${}^{**}D = \frac{60}{h} \times \text{cycle distance} \times \text{C.F.}$$

$$\text{where C.F.} = \begin{cases} N_2/N_1 & \text{if } N_2 > N_1 \\ 1 & \text{if } N_1 \leq N_2 \end{cases}$$

Sea-Bus

First hour:

6-2/3 sailings
 2 sailings deadheading
 Three ships

Second hour:

5-1/3 sailings
 Two ships

Totals

Number of crossings: 12
 Hours: 2
 Distance: 56 st. miles

Scenario 2 Bus and Ferry Service

- five hourly trans-bridge buses
- Sea-Bus for rest of transit trips
- half of Sea-Bus passengers use park-and-ride or kiss-and-ride facilities

Transit use assumptions

- For a loading of 51 passengers, the total number of bus patrons is:

$$51 \times 10 = 510$$

- Sea-Bus ridership is

$$2\ 507 - 510 = 1\ 997$$

- Ridership by hour:

first hour	1 198 ferry	255 bus
second hour	799	255

- feeder bus headway is same as ferry for proper service integration

Required ferry headways:

first hour	20 minutes
second hour	30 minutes

Ferry requirements:

first and second hour 2 vessels

Trans-bridge Buses

First Hour:

Tract	Pax	h	N	D
130/131	102	60	2	30
132	51	60	2	18
133/134	51	60	2	26
135	51	60	1	14

Second Hour:

Tract	Pax	h	N	D
130/131	102	60	2	30
132	51	60	2	18
133/134	51	60	2	26
135	51	60	1	14

Feeder Buses

First Hour:

Tract	Pax	h	N	D
130/131	314	20	3	45
132	116	20	2	24
133/134	102	20	3	48
135	67	20	3	27

Second Hour:

Tract	Pax	h	N	D
130/131	209	30	2	20
132	77	30	1	16
133/134	27	30	2	32
135	45	30	2	18

Totals:

Buses:

Hours: 2
 Buses: 30
 Distance: 406

Ferry:

Vessels: 2
 Miles: 40
 Hours: 2
 Dockings: 10

Scenario 3 Bus Equivalent Service

This section assesses the requirement for providing equivalent service by bus, during the two hour peak as an alternative to the ferry-only service. The same number of patrons will be served, with a 60/40 split between the first and second hour.

Trans-Bridge Bus

First Hour:

- total ridership in first hour 1 504.

Tract	Pax	h	N	D
130/131	750	10	13	220
132	122	10	7	108
133	172	10	10	156
134	264	10	4	102
135	197	10	5	84

Second Hour:

- the total remaining ridership is 1 008

Tract	Pax	h	N	D
130/131	500	10	9	162
132	81	10	7	108
133	114	10	10	156
134	176	10	4	102
135	131	10	5	84

Totals

Buses: 74

Hours: 2

Distance: 1 282

12. Cost Base: 1979 West Vancouver Municipal Bus Operation

The following statistics were obtained from the West Vancouver Bus schedule and operating statistics between February 26 and March 16, 1979:

Buses: 21

Hours: 3

Distance: 487

The base value for operating costs is:

$$\begin{aligned} \text{O.C.} &= 10.97 (3 \times 21) + 0.448 (487) + 5.55 (21) \\ &= 1 025.84 \end{aligned}$$

13. Scenario Operating Costs

Scenario 1

Feeder costs:

$$\begin{aligned} \text{O.C.}' &= 10.97 (1 \times 17 + 1 \times 12) + 0.448 (350) \\ &\quad + 5.55 (29) \\ &= 1 495.67 \end{aligned}$$

Total Operating Cost:

$$\text{T.O.C.} = 2 134.61$$

Scenario 2

Trans-Bridge Service Cost:

$$\begin{aligned} \text{O.C.}' &= 10.97 (2 \times 7) + 0.448 (176) + 5.55 (7) \\ &= 271.28 \end{aligned}$$

Feeder cost:

$$\begin{aligned} \text{O.C.}' &= 10.97 (1 \times 11 + 1 \times 7) + 0.448 (230) \\ &\quad + 5.55 (30) \\ &= 467.00 \end{aligned}$$

Sea-Bus cost:

$$\begin{aligned} \text{O.C.} &= 138.05 (2 \times 2) + 8.75 (40) + 22.53 (10) \\ &= 1 127.50 \end{aligned}$$

Total Operating Cost:

$$\text{T.O.C.} = 1 865.18$$

Scenario 3

Trans-Bridge Bus Cost:

$$\begin{aligned}
 \text{O.C.} &= 10.97 (1 \times 39 + 35) + 0.448 (1 282) \\
 &\quad + 5.55 (74) \\
 &= 1 796.82
 \end{aligned}$$

Total Operating Cost:

$$\text{T.O.C.} = 1 796.82$$

14. Summary Table of Comparative Operating Costs

Operating Costs	Present	Ferry	Bus-Ferry	Bus Equivalent
Dollars Cost	1 025.84	2 134.61	1 865.778	1 796.82
Indexed to Present Cost	1	2.08	1.82	1.75
Indexed to Bus Equivalent	0.57	1.19	1.04	1

Table A-1 Summary Table of Comparative Operating Costs

FOOTNOTES

¹Urban Transit Authority, UTA Briefing Manual ([Victoria], [1978]), pp. 102-104.

²Corporation of the District of West Vancouver, Financial Statement (West Vancouver, B.C.: Corporation of the District of West Vancouver, 1978), pp. 8, 10, 21.

³Peat, Marwick, Mitchell and Company, Modal Split Model (San Francisco: Peat, Marwick, Mitchell and Company, [1970]), pp. 4-6, Exhibits 2-A - 3-A.

⁴The operating assumptions used in these and the following bus requirement calculations, are summarized in the table below:

Tract	cycle distances: (miles)		cycle times: (minutes)	
	to ferry terminal	to CBD Vancouver	to ferry terminal	to CBD Vancouver
130/131	5	15	20	50
132	8	18	30	66
133	16	26	60	100
134*	7	17	30	40
135	9	9	50	50

* This downtown service requires a transfer to one of the trans-bridge routes for bus service to CBD Vancouver.

⁵See note in footnote 4.

Appendix 2

1. Annual operating costs for a bridge at Brockton Point

The operating cost for the former Brockton Point Bridge is quoted below:

Annual Allowance For Operation and Maintenance

Repainting	\$ 37,000
Roadway resurfacing and maintenance	46,000
Inspection and miscellaneous maintenance	37,000
Power	55,000
Traffic patrol	<u>133,000</u>
Total	<u><u>\$308,000</u></u>

Source: Swan Wooster - CBA The Burrard Inlet Crossing, a report to the National Harbours Board, Volume 1 (Vancouver, B.C.: National Harbours Board, 1970), p. 223.

Correcting for inflation, at 9 per cent over nine years, the present operating cost for such a structure would be 729 148 dollars. This cost is allocated to the peak periods by dividing by two. Dividing this by the total number of lanes (six), the per-lane cost is 60 763 dollars per annum. One lane was stated to provide a vehicular capacity of 2 000 vehicles per hour, or on the assumption that car occupancy is 1.3, then one lane would transport 2 600 persons per hour. This is roughly twice the hourly patronage that is to be carried by the various Scenarios developed in Appendix 1. Therefore, half a lane is required.

2. Annual operating cost of transit without administrative costs

Removing administrative costs from the unit operating cost formulas developed in Appendix 1, parts 6 and 7, one obtains the following values for peak-period operating and maintenance cost:¹

Scenario 1	1 851.60	(1979 dollars)
Scenario 2	1 575.43	
Scenario 3	1 386.12	

The annual costs for each of the scenarios is obtained by multiplying the daily peak-hour costs above by:

$$5 \text{ days/week} \times (52 \text{ weeks/year} - 1 \text{ week of holidays/year})$$

The annual operating costs become:

Scenario 1	472 158	(1979 dollars)
Scenario 2	401 734	
Scenario 3	353 460	

Note: Total annual operating cost for Scenario 2 and 3 must include a portion of the bridge operating cost discussed in part 1 of this Appendix. The apportionment is based upon the capacity of the bridge, each requires:

Scenario 2	1/4 lane over two hours
Scenario 3	1/2 lane over two hours

Since it is assumed that the backlog of morning traffic is capable of taking up any bridge capacity freed up in Scenario 1 or 2, there is no need to offset any allocations of capital and operating costs of this added capacity.

¹New formulas are:

$$\begin{aligned} \text{O.C.} &= 138.05 \text{ (hours)} + 8.75 \text{ (miles)} + 14.03 \text{ (sailings)} \\ \text{O.C.}' &= 10.97 \text{ (hours)} + 0.448 \text{ (miles)} \end{aligned}$$

Appendix 3

1. Cost of fleet expansion

At the present time, the West Vancouver Municipal Transportation System has thirty-two (32) buses, and not more than four (4) are idle during the morning peak-hour period.¹ The buses required for the peak period are basically set by the first hour in the period because of the 60/40 split assumed in preferred use of transit. (see Appendix 1, part 10) Hence, Scenario 1 does not require purchase of additional buses.

Diversion of the currently used trans-bridge vehicles and the reduction in total route mileage, account for this. Scenario 2 also is assumed not to require additional buses since the route mileage is about the same as the present peak-hour service. (see table 2 in text of chapter five)

However, the case is different for Scenario 3. The number of trans-bridge bus trips nearly triple from 21 to 74 in the peak period. The peak period has also been assumed to shorten from nearly three hours to just two.

(see Appendix 1, part 11, Scenario 3) The required number of buses to be added can be roughly assessed in terms of peak period crossings to fleet size proportions, committed to trans-bridge operation. From the calculations that follow, twenty (20) buses must be acquired for Scenario

3.

$$\begin{aligned}
 \text{Extra} \\
 \text{Buses} \\
 \text{Required} &= \left\{ \left(\frac{\text{Scenario 3 bridge crossings}}{\text{Present number of bridge}} \right) \left(\frac{\text{Fleet}}{\text{Size}} \right) \right\} - \left(\frac{\text{Present}}{\text{Fleet}} \right) \\
 &= \left\{ \frac{39}{24} \times 32 \right\} - 32 \\
 &= 20
 \end{aligned}$$

The value in the denominator is the number of buses on trans-bridge service -- this excludes four buses in the depot, three on school bus routes and one on the British (Pacific) Properties loop.²

For the type of General Motor bus used in West Vancouver -- with automatic transmission, generally more comfortable interior, etc. -- the purchase cost is about 107 000 dollars.³ Total capital expenditures required for Scenario 3 is 2.14 million dollars.

Scenario 1 and 2 do not require any buses to be purchased. However, capital expenditures are necessary for acquiring Sea-Bus type vessels.

The cost of a Sea-Bus⁴ was 3.6 million in 1977, and correcting for inflation, currently would cost 4.3 million dollars. Scenario 1 requires three Sea-Buses -- costing 12.9 million -- and Scenario 2 requires two Sea-Buses -- costing 8.6 million dollars.

2. Terminal Costs

Capital costs associated with the terminal facilities at West Vancouver, are roughly:

Floating terminal	10.0 million
Passenger facilities	1.5 million
Other	1.0 million
Contingencies	0.8 million
<hr/>	
Total	13.3 million
Or correcting for inflation	15.8 million

This figure excludes start-up costs and assumes all park-and-ride and station facilities are included in the 'other' or in the 'contingency' categories.

3. Capital Costs for a Bridge Similar to the Former Brockton Point Proposal

Capital costs for the construction of a bridge similar to the 1970 Swan Wooster - CBA proposal for a crossing at Brockton Point, are the bases for a bridge alternative. Table A-2 indicates that capital costs for such a bridge would be 100.5 million in 1970, or correcting for inflation, 218.3 million current dollars.

TABLE A-2 Bridge Capital Costs

See: Swan Wooster-CBA, The Burrard Inlet Crossing, vol. 1,
a report to the National Harbours Board (Vancouver,
B.C.: National Harbours Board, 1970), p. 223.

FOOTNOTES

¹Interview with Dr. Don Grant, Assistant General Manager of West Vancouver Municipal Transportation on March 23, 1979.

²Follow-up telephone conversations with Mr. Don Grant on March 23, 1979 and April 4, 1979.

³ibid.

⁴Planning 505 lecture by Mr. T. Parkinson, on December 6, 1977

Appendix 4

All capital costs are assumed to be partitioned over the peak-hour periods during the year (2 hours in the morning and 3 hours in the evening), since these expenditures mainly address the peak-hour problem.

1. Scenario 1 Capital Costs

Capital costs are related to three Sea-Buses and one terminal. The full cost of the terminal is assessed, although it would have reserve capacity. The yearly cost is estimated to be:

$$28.7 \text{ million} \times \text{CRF} = 2.50 \text{ million dollars}$$

where the Capital Recovery Factor is 0.08718, 6% at 20 years.

2. Scenario 2 Capital Costs

Capital costs are related to two Sea-Buses and a terminal.

Total estimate is:

$$24.4 \text{ million} \times \text{CRF} = 2.13 \text{ million dollars}$$

with the same assumptions and CRF as above. However, capital cost of bridge use by the trans-bridge buses must be apportioned, for one-fourth of a lane capacity that is used.

3. Scenario 3 Capital Costs

This includes the capital cost to purchase twenty buses:

$$2.14 \text{ million} \times \text{CRF} = 0.29 \text{ million dollars}$$

where the Cost Recovery Factor is 0.13587, 6% for 10 years. As in the previous case, it is necessary for bridge costs to be apportioned. In this case, one-fourth a lane capacity over two hours is required.

4. Bridge Transit Capital Costs.

Bridge capital costs to be apportioned to buses, assumes existing structures will be used. The capital costs for one-half a lane per hour capacity is estimated as:

218.3/12 half lanes. = 18.2 million

or

18.2 million X CRF = 1.32 million dollars

where CRF is 0.07265, 6% for 30 years.

Note: To obtain the morning peak-hour yearly cost, each capital cost figure must be multiplied by 1/2, since the morning peak is more intense.

5. Summary of table 6 cost derivations

Scenario 1

Operating:	.47 millions of dollars
Capital:	
Ferry and terminal	1.25
Total	1.72

Scenario 2

Operating:	
Bus, ferry	.40
Bridge use	.03
Sub-total	.43
Capital:	
Ferry and terminal	1.07
Bridge	.33
Sub-total	1.40
Total	1.83

Scenario 3

Operating:	
Bus	.35
Bridge use	.06
Sub-total	.41
Capital	
Buses	.15
Bridge	.66
Sub-total	.81
Total	1.22

6. Total costs assuming 12% interest rate

i. Capital Costs:

Scenario 1	28.7 X .13388 = 3.85 million
Scenario 2	24.4 X .13388 = 3.27
Scenario 3	2.14 X .17698 = .38
1/2 bridge lane	18.2 X .12130 = 2.21

ii Total Costs derived:

Scenario 1

Operating:	.47 millions of dollars
Capital:	
Ferry and terminal	1.93

Total

2.40

Scenario 2

Operating:	
Bus, ferry	.40
Bridge use	.03
Sub-total	.43
Capital:	
Ferry and terminal	1.64
Bridge	.55
Sub-total	2.19
Total	2.62

Scenario 3

Operating:	
Bus	.35
Bridge use	.06
Sub-total	.41
Capital:	
Buses	.38
Bridge	1.10
Sub-total	1.48
Total	1.86

Appendix 5Physical Specifications¹

Ferry:	Length by width	34 m X 13 m
	Draft (loaded)	2 m
	Capacity	400 per vessel
	Crew requirements	4

Floating Terminal:

Length by width	80 m X 81 m
Berth length	36 m
Depth of hull	5 m
Enclosed floor area	1 950 m ²
Capacity	9 600 passengers per hour (Assumes one ferry requires five minutes to approach, load, unload and depart.)

Layout of floating terminal with one Seabus at berth and one berthing:

See: John N. Case, The People Mover (Victoria, B.C.: Case Existological Laboratories, Ltd., [1975]), p. 6.

¹Information provided by Mr. C. Spratt on October 24, 1978