A STUDY OF THE OPPORTUNITIES AND COSTS OF PRESERVING RECREATION SITES ALONG THE LOWER FRASER RIVER

by

BROCK FREDERICK JAMES FRIESEN

B.A.(hon), Simon Fraser University, 1972

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the School

of

Community and Regional Planning

We accept this thesis as conforming to the

required standard

THE UNIVERSITY OF BRITISH COLUMBIA

April, 1974

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representative. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

School of Community and Regional Planning

University of British Columbia

April, 1974

Abstract

The purpose of this study is to examine the social opportunity cost of preserving specified recreation sites along the lower Fraser River. In achieving this purpose it does the following:

1. it examines the institutional arrangements whereby land is allocated to specific uses,
2. it identifies the potential recreation sites for possible preservation,
3. it assesses the nature and extent of the conflict between recreation sites and existing and potential industrial shoreland use,
4. it develops an analytic framework for examining the social opportunity cost of preserving recreation sites,
5. it applies the framework to determine the benefits which the region might forgo if it were to preserve the recreation sites identified.

An examination of the institutional setting found that private markets alone may not provide recreation facilities in the lower Fraser in accordance with society's willingness to pay for them. Public institutions have evolved to regulate the market, however, and an analysis of the social opportunity cost of preserving recreation sites is made in order to assist decision makers in future shoreland allocations. For this analysis to be meaningful it was necessary to identify specific recreation sites, and to determine the nature and extent of the

conflict between these and industrial use. Thirty-two major recreation sites were identified. About two-thirds of these were found to conflict with potential industrial needs for shoreland designated industrial by the Regional Plan, and with log storage activities of the forest industry. Ideally a technique for allocating shoreland to recreational or industrial uses should be based on an assessment of the benefits and costs of alternative land uses. However, an opportunity cost approach is all that is practicable at this time because of the difficulties associated with evaluating present and future recreation demands. A qualitative approach to the evaluation was devised because past attempts to measure social opportunity cost were not appropriate in this situation where concern was primarily with demand far into the future. The analysis focussed on the rental value differences between industrial use of shoreland and upland, the supply and demand for industrial shoreland, and the cost of log storage alternatives.

The analysis produced four main findings. First, most firms do not attach a significantly higher rental value to shoreland than to upland sites. Second, the supply of waterway access is much greater than anticipated industrial demand, and the opportunity cost of preserving land with recreation potential is zero in the short run. Third, the study area has sufficient land designated industrial that a small reduction for the preservation of recreation sites will not affect the land market. Four, seasonal storage leases and bundle booming can be implemented to free recreation sites of stored logs without incurring a net opportunity cost.

Acknowledgement

I would like to thank Prof. Irving Fox and Dr. Jon O'Riordan, my advisors, for the direction and criticism they have generously supplied in the preparation of this thesis. In addition I would like to thank Mr. Ken Petersen for patiently reading and rereading the many drafts of this manuscript, and the Westwater Research Center which funded the collection of much of the data used. Although not directly involved, special thanks go to Dr. Ed Gibson for the motivation and confidence provided through his friendship.

Table of Contents

List of Figures

List of Tables

Chapter One

Scope and Objectives

A rapidly emerging planning issue in the Greater Vancouver region is the allocation of shorelands along the Fraser River. Part of the area's waterfrontage is currently used for industrial sites, and the Official Regional Plan has fostered a continued growth in the industrial use of shoreland by designating the bulk of the largely unused lands for such activities. Recently recreationists have begun to demand that certain sites be preserved for public recreational use, and they have produced a number of studies which have appealed for government action to prevent indiscriminate development of specific sites. Action has also been demanded to restrict log storage activities which limit foreshore use for recreation purposes.

Evidence of a new concern for recreation in the Fraser shorelands is expressed in numerous reports (eg., Halladay and Harris: 1972, Pearson: 1973, Watmough: 1972, and Wersta: 1973). Particularily strong interest has been expressed by the Recreation Policy Committee of the Greater Vancouver Regional District's Liveable Region Program (G.V.R.D.: 1973) which has

urged the establishment of a board to manage areas of the River suited to recreation use, the assertion of public right of access to all foreshore and River waters, and the possible use of Greenbelt Act funds to acquire shoreland for recreation sites.

Although recreational interest in the Lower Fraser is being expressed with increasing intensity it has been mainly concerned with specific sites, and frequently very little is known about each of them. The reports which have been mentioned and those which are listed in Appendix II have either been confined to small areas, have only considered single uses such as bar fishing, or have been very superficial in nature. These observations have prompted the Recreation Policy Committee to recommend a cataloguing of potential recreation areas.

Preliminary investigations indicated that industrial use and needs for shoreland were complex and unclear. It was noted that industrial activities not only use shorelands in the traditional sense as sites for plants or related structures, but much of the shoreline was also extensively used for the storage of logs. While this use is less important from the point of view of permanent destruction of natural landscapes, it does prevent the use of several upland and foreshore areas by recreationists and is likely to be the most immediate problem. Conflict with upland use is less obvious as Figure One illustrates that much of the shorelands are vacant or agricultural in aspect.

But while it can be observed that upland sites have not as

yet been extensively occupied by industry, regional land-use policy has widely favoured the expansion of industrial use. The Lower Mainland Regional Plan (L.M.R.P.B.: 1966) has designated the largest portion of the Fraser shoreland within the G.V.R.D. for industrial use. More recently, Forward's (1968) study of the present use and future demands for shoreland, and the G.V.R.D.'s (1971) study of the future industrial development of the Region have both reinforced the Regional Plan's allocation for industrial use. The former considers the Fraser as "well suited to accomodate the great majority of the region's water-oriented industry", and the latter estimates that even with the large areas already designated for industry there will only be enough shoreland to accomodate the needs to the year 2000.

A. OBJECTIVES OF THE STUDY

One may appropriately ask whether there is any reason to believe that existing institutions do not allocate shoreland to serve the best interest of society. One of the initial tasks of this study, therefore, was to examine existing institutional arrangements to determine how shorelands are allocated. There is clear evidence that because of the limitations of market forces public institutions intervene in the allocation of shoreland. This thesis examines the information needed by decision makers in deciding how shorelands should be allocated, and attempts to fill some of the gaps in the information currently available.

In deciding whether it is advisable to allocate shoreland to recreation uses, public officials must, in effect, determine whether a given parcel of land will yield greater benefits to society if used for recreation than if it were used for other purposes. The comparison of the benefits and costs of alternative shoreland uses requires an assessment of the recreation potential, the benefits of the recreation uses, the value of industrial production, and the costs associated with the construction and maintainance of both activities at inland and shoreland sites. Although some of the information necessary for this type of evaluation was collected, weighing the benefits and costs of alternative uses to arrive at the net benefits each use will produce is a difficult task for reasons that are explained more fully later on in this thesis. Confronted with this difficulty it was decided that this study should focus upon the benefits society would forgo if certain shorelands were allocated to recreation uses. These benefits forgone are referred to as the "social opportunity cost" of preserving specified sites for recreation purposes. It is the purpose of this thesis to examine this cost.

B. DEFINITION OF THE STUDY AREA

A number of reasons can be cited for selecting the G.V.R.D. as the study area (shown in Figure One). It is the area where most of Fraser Valley's population is concentrated, and therefore, the area most likely to experience intense land

use conflicts. The depth and channel characteristics upstream from the G.V.R.D. restrict the potential industrial use of this section of the River. Because many of the land uses transcend municipal boundaries, and because the Regional Government is playing an ever-increasing role in the allocation of land it is also the most important decision making unit.

The terms shoreland and shorezone will be used interchangably in this study to include not only the narrow strip on either side of the shoreline, but also the upland and the offshore waters insofar as they affect each other. While it is conceded that such a definition is unsatisfactorily circular, it allows the boundaries to vary with the allocation problem at hand. If the problem concerns log booming it will extend from the affected intertidal foreshore into the adjacent water area; if the problem concerns a major industrial site it can include the necessary depth and breadth of upland.

C. ORGANIZATION

In Chapter Two the institutional setting is examined to determine whether an evaluation of social opportunity cost is worthwhile.

In Chapter Three recreation sites potentially valuable for recreation purposes are identified.

In Chapter Four, the nature and extent of the conflicts between use of identified sites for recreation purposes and

existing and potential industrial use of these areas is determined.

In Chapter Five, by drawing upon applicable literature a methodology for making a qualitative assessment of the social opportunity cost of reserving the identified sites for recreation purposes is developed.

In Chapter Six, the methodology is applied to the identified potential recreatiion sites and the evaluation is made for industrial activities requiring plant locations.

In Chapter Seven, three log storage alternatives are examined to determine the opportunity costs of using these to free recreation sites.

The concluding chapter summarizes the findings of the study.

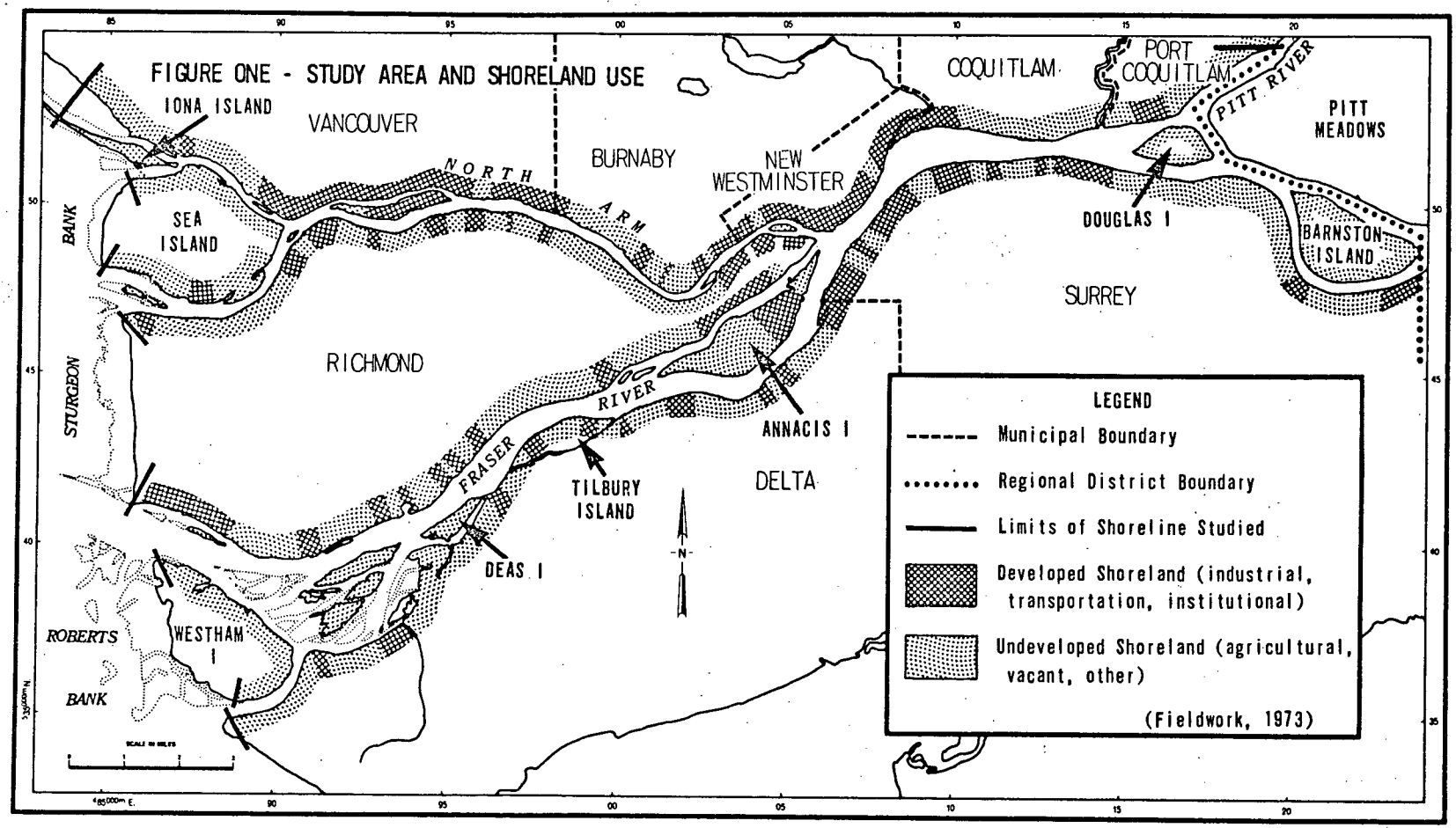


FIGURE ONE - STUDY AREA AND SHORELAND USE
IONA ISLAND
VANCOUVER
BURNABY
NEW WESTMINSTER
COQUITLAM
PORT COQUITLAM
PITT RIVER
PITT MEADOWS
NORTH ARM
SEA ISLAND
BANK
DOUGLAS I
BARNSTON ISLAND
SURREY
RICHMOND
STURGEON
FRASER RIVER
ANNACIS I
TILBURY ISLAND
DELTA
DEAS I
ROBERTS BANK
WESTHAM I
N
LEGEND
Municipal Boundary
Regional District Boundary
Limits of Shoreline Studied
Developed Shoreland (industrial, transportation, institutional)
Undeveloped Shoreland (agricultural, vacant, other)
(Fieldwork, 1973)

Chapter Two

The Institutional Setting

A very large number of demands are placed on the supply of land. Obvious major users include housing, agriculture, industry and recreation. A number of variables influencing this demand can be listed: population growth, disposable income, leisure time, transportation technology, consumer preference, and the competitive position of a region's industry in national and world markets (Beaulieu and Maxwell: 1972). Because of the complexity of these highly interrelated socio-economic and technological considerations, problems of land allocation are both difficult and dynamic.

Decision making about land use has historically been widely dispersed among literally millions of persons (individual and corporate) and a host of public agencies. These interests are primarily organized by the market mechanism under the guidance of a number of institutional controls. The purpose of this chapter will be to outline the way both the private market and the existing institutional arrangements work in allocating shoreland, and to investigate their apparent shortcomings.

A. PRIVATE MARKET FAILURES

If the efficient allocation of shoreland is defined as that spatial distribution which maximizes the value-in-use for individual parcels of land, and if all parcels are allocated to those activities which are willing-to-pay the most for them, the total sum of rental fees will be maximized. This definition is based on the theory of rents where the rental value of a parcel of land is bid up to a point where it exhausts the profits of the activity occupying that parcel. In a free market economy the bidder who pays the highest price will obtain the right to use any given parcel of land. The price paid is a function of the demands placed on a particular parcel of land because of its particular combination of resources and accessibility. Because some parcels of land may be of greater value than others, and some users may be able to pay more for a parcel they desire, it is argued that competition among users will generate the greatest amount of income per acre, and sites will be occupied by the use which is of greatest economic value. This is often referred to as the "highest and best use".

For the market to allocate land efficiently the price of the land must reflect the value of all services which could be produced on the land. Under certain conditions, however, the willingness-to-pay of consumers for these resources may not be registered: the existence of collective goods, decreasing cost industries, externalities, and option values. Because these imperfections preclude the expression of willingness-to-pay, market prices may not reflect society's willingness-to-pay for

recreational use of Fraser shorelands. Therefore, land may not be allocated to the uses which are of greatest economic value.

The provision of a recreation facility on the Fraser shorelands can be termed a collective good. In considering the problems associated with collective goods it is necessary to distinguish them from private goods. The important characteristic of private goods is that consumption or use of a unit of good by one individual effectively prevents someone else from consuming the same unit of that good. Collective goods on the other hand, are usually consumed communally and cannot be individually packaged and sold. One person's consumption of a good such as a fishing bar or nature walk does not prevent, and frequently does not diminish, the enjoyment of that good by another person. These definitions represent ideal types and a great number of goods do not fit exclusively into either category.

Because of the communal nature of collective goods, a person who provides them for himself will be providing them without cost to others who may wish to use them. For example, if a shipping company builds a lighthouse for its fleet, all shipping in the vicinity will be able to benefit from its signal. It follows that shipping companies will be reluctant to build lighthouses in hopes that other shipping companies will build them. This example can be readily applied to the provision of recreational facilities on shoreland if we assume that persons will seek to minimize their own expenditure, and hope that someone else will build and maintain parks and

beaches. In such cases, therefore, there is likely to be a severe underprovisioning of goods of this type, and some form of non-market action is required if goods which individuals will not pay for, but groups in society as a whole will, are to be provided.

The problems associated with decreasing-cost industries, such as the provision of a recreation facility on the Fraser shorelands, can be described in terms of the following example. Suppose that an additional unit of a good which is presently being produced could be supplied to a consumer at a very low cost. The additional cost is termed the marginal cost and it will pay a producer to supply the extra unit at any price above his marginal cost. In a competetive market, theory has it that the price for all units will be driven down to this marginal cost (not just for the additional unit), and as a result resources will be allocated in the most efficient manner possible.

The critical assumption of this model is that beyond a certain point, there exist diseconomies of scale. However, there are some industries for which marginal costs are always decreasing. Shoreland recreation facilities can be cited as examples of this situation because most of the production costs associated with them are incurred at the time of construction, and much of the wear and tear will be a function of time rather than use, thus yielding a situation where little or no costs are involved in allowing access to an additional fisherman or beachcomber. If an industry of this type sets its prices equal

to marginal cost at a level below average cost it will soon face bankruptcy. In other words the essential condition of successful free enterprise, that total revenue exceed total cost, will not be met if the marginal costs are less than average costs and prices are set according to marginal costs. If average costs are charged, the industry will break even but the goods produced will be underutilized and the resources inefficiently distributed.

If recreational goods produced by these types of industries are to be supplied, they must either be marketed at average cost, or society must be prepared to subsidize the industry to make up the difference between average and marginal cost. In the first instance, because of scale efficiencies, competition is unworkable and the rise of monopolies will be favoured which will involve greater inefficiencies of allocation as monopolies will tend to restrict output in order to set prices at a point that will maximize profits. If society chooses to subsidize the production it will have to be done from a general taxation not from levies on the consumers involved as this would amount to raising the price of the good to the average cost.

It can be seen, therefore, that private markets cannot efficiently produce and allocate goods, while at the same time make a profit, in the case where the marginal cost of production is less than the average cost of production. The importance of this situation lies in its pervasiveness, affecting as it does virtually all transportation and communication services. Outdoor recreational facilities naturally fall into the category

of decreasing-cost industries in that they are characterized by very high fixed costs and very low variable costs. As a result marginal cost very often approaches zero while average cost (although it falls in direct proportion to numbers of users) may be considerable. The logical conclusion of this analysis is that private industry will not be able to provision society with outdoor recreation facilities on Fraser shorelands in an efficient manner.

The third market failure relevant to the allocation of shoreland concerns the production of physical, social and economic side-effects. These spillover effects on often unrelated third parties are not reflected in the individual input-output calculus of the firm, and no market mechanism exists whereby a consumer can pay either to consume it or avoid it (O'Riordan: 1971). An essential characteristic is that the external effect produced "is not a deliberate creation but an unintentional or incidental by-product of some otherwise legitimate activity" (Mishan: 1971). Common examples of these in the shorezone might include unsightly buildings, excessive smoke, and liquid waste discharges.

The importance of externalities in the shorezone may be great if land is allocated on the basis of market prices which do not take them into account. Externalities impose costs on goods which industries may consider free, but society as a whole may consider scarce; and the market price only reflects the value of land as a private good rather than as a common property good. Society as a whole may be willing to pay a great deal to

safeguard the quality of its waters or the aesthetic environment of its urban shorelands, but because land is allocated by the market, too much land may be allocated to those uses with undesirable negative spillovers.

The fourth market failure concerns the need to consider values in anticipation of use. In the Fraser shorelands, as well as in much of North America, we have grown accustomed to making decisions largely in terms of present day criteria. However, the need to consider the future is becoming more readily apparent as population densities increase and the permanence of man's effect on the land is realized. Once a parcel of shoreland is taken out of its natural state (ie. developed), then subsequent owners must pay not only the opportunity costs inherent in its locational and site advantages, they must also pay the capitalized value of any improvements that a prior owner had put on the land. In addition they may have to overcome any negative externalities associated with the previous use. Because a recreation site relies on its natural character it will probably be impossible, or at least very costly, to convert certain types of urban or industrial land use back to a natural recreation use. The original untouched appearance can never be recaptured.

Because the market has no way of assigning a price to the "option value" of preservation, in cases where present demands are not great shoreland may be allocated to users which do not take advantage of a particular locational attribute such as a shoreline. Subsequent users of shoreline land may be penalized

unnecessarily in that goods may not be provided, be more expensive, or be in less demand if they were not provided at the shoreline. Obvious examples include fishing and swimming.

Thus it has been demonstrated that private markets are unlikely to provide recreation facilities on the Fraser shorelands in a manner which is consistent with society's willingness-to-pay for such facilities. Because parks and recreation facilities have not been provided in significant numbers by private industry, either on the shorelands or elswhere in the region, governments have had to intervene for this purpose. The role of government agencies will be discussed in the next section.

B. PUBLIC INSTITUTIONAL REGULATION

A number of shortcomings of the market mechanism have been illustrated, and it is clear that extra-market action is essential in order to minimize the effects of these limitations. This is not a new revelation as it can be observed that governments have already initiated several regulatory measures. The main constraints are harbour authority regulations, and regional and municipal zoning. They have not replaced the market, they have only imposed broad limits within which it can function freely and often very well. The purpose of this section will be to examine the jurisdictional arrangements which have evolved to constrain the market mechanism, and point out any limitations which might impair effective public action.

The peculiar nature of shorelands at the water-land interface has been a major determinant in the evolution of public regulatory bodies. Because of this, traditional municipal and regional zoning has been supplemented by two Federal bodies -- the Fraser River Harbour Commission on the Main Arm, and the North Fraser Harbour Commission on the North Arm. The powers granted to these bodies make them the most important of all bodies and they will be discussed first. Following that a number of Provincial Statutes will be mentioned, and the roles of regional and local governments reviewed.

The Federal government has set up a series of individually incorporated Harbour Commissions to administer the property of public harbours which had been transferred from the provinces to the Federal Government at the time of Confederation. As a result of this the federal government has two levers of power with respect to harbours - proprietary rights and administrative responsibilities. The harbours controlled by the federal government were those used as such at the time of British Columbia's entry into Confederation; and only the parts of each that were actually in use were transfered. Federal ownership of land includes the river bed and intertidal foreshore (LaForest: 1969). There were several problems in specifying what was and was not a harbour in 1871, but the situation was clarified somewhat by the Six Harbours Agreement in 1924 which classified New Westminster as a federally owned harbour. Future extensions, however, remained the property of the provincial

government. This accounts for such anomalies as the North Fraser Harbour Commission which is a federal administrative agency with control over provincially owned land.

The Harbour Commission Act (S.C: 1964: s.2) joined the acts which originally incorporated both of the Commissions and restated their powers. Because they are responsible to the Ministry of Transport, and only two representatives from adjoining municipalities are appointed (by their councils), the Commissions enjoy a considerable amount of independence from local jurisdictions and local public sentiment. The powers of the Commissions are extensive and they include: "the regulation and control of use and development of all land, buildings and property within the limits of the harbour, and all docks, wharves and equipment erected or used in connection therewith." In addition the Commissions are empowered to acquire land, build wharves and structures, and to sell and lease the same; and if they see the need, the power to expropriate was also granted (S.C.: 1964-1965: s. 9 and 19). The Commissions' most important role concerning the study area is their power to lease underwater land and water lots under their jurisdiction regardless of the level of government owning the land. The execution of this power is very complex, however, as the Commission must often lease land which it does not own in order that it may re-lease it to prospective users. Any industry wanting to use foreshore or adjacent water areas for log booming or barge berths must lease it from the Commission.

The powers of the Commissions are vast with respect to

shorelands, and they have the power to set aside lands which they own for recreational use, and to designate other shorelands for these uses as well. The Commissions, however, have generally not taken such measures and have relied on municipal and regional zoning to determine upland use. But, if they felt it was in the public interest they could override local zoning ordinances. Their control over foreshore and adjacent waters is absolute on lands (including water lots) which they own, and nearly so on Provincial lands which they administer. Most important of their powers with respect to recreational activities is their ability to lease and regulate water lots for log storage. The Commissions' policy in this regard has been to grant log storage leases to anyone who can secure the consent of the upland owner. The upland owner's permission is required if logs stored adjacent to upland property impede the right of access to the property by water (ie., if logs are stored above or in close proximity to the low water mark). This need for the prospective tenant to secure the upland owners riparian rights has led to the situation whereby forest companies have purchased long narrow strips of shoreline upland to avoid complications and payments arising from these transfers. However, while this has been the Commissions' policy in the past, they do have the discretionary power not to grant leases in situations where it may be desirable to preserve water access for shoreland recreational use.

While the powers of the Harbour Commissions are great, they were not set for the specific function of providing recreation facilities on shorelands. Because they are responsible for

generating sufficient revenues to maintain themselves, they have been put in a position of having to favour uses which will produce higher revenues through the granting of shoreland leases for log storage, docks or other installations. As a result it is in their interest to encourage development and uses which can pay them the most for these lands. It may be that they are financially unable to consider the provision of recreation facilities, and that if they are to manage harbours so as to overcome market failures and provide collective goods which are in the public interest, they may need alternative sources of revenue.

The Province has a number of jurisdictional levers. Although the Harbour Commissions are paramount over Provincial authority on lands which the Province owns, it can place some limits on the Commissions' powers. The Land Act protects tidal land and foreshore from preemption and alienation. By virtue of this Act, the Province has some limits over the Commissions in that filling in the foreshore in provincially owned areas would not, for example, be considered a right of jurisdiction (R.S.B.C.: 1960: c. 206). A second important Provincial Statute is the Park Act (R.S.B.C.: 1965: c. 31). By authority of this legislation the Lieutenant-Governor in Council may establish any area of Crown Land as a park, a recreation area, or a natural conservancy area. Because these must be on Crown Land the Act also permits the acquisition by purchase or expropriation, lands which it would like for these purposes. The Province, however, has not utilized this Act in the study area to date.

The most powerful provincial legislation is the Land Commission Act (R.S.B.C.: 1973: c. 46). This Act empowers a commission to preserve agricultural land, preserve green belt land, and preserve park land for recreation. Although the weight of his legislation has only been felt with respect to agricultural land so far, it is potentially one of the strongest means of preserving shoreland recreation sites.

The focus of the Greater Vancouver Regional District's power is in establishment of a regional plan. Once enacted by the Regional Board, the Regional Plan governs all land use within the district; and "neither the Regional Board nor the Council nor the Trustees of a member municipality, as the case may be, shall enact any provision or initiate any works which would impair or impede the ultimate realization of the objectives of the regional plan or any part or parts thereof" (B.C.: 1971). The Offical Regional Plan was adopted in 1966 by the Lower Mainland Regional Planning Board, each of its 28 member municipalities, and the Provincial Government. When the Board was disbanded in 1969 responsibility for the Plan was transfered to the Greater Vancouver Regional District and three other regional districts in the rest of the Lower Mainland area. The Plan was conceived of as a policy framework within which local policies could be formulated, and a "Current Stage Plan Map" was drawn which designated all land as being one of five possible types of "development area" -- urban, rural, industrial, park, and reserve. While the Plan is a powerful document it is limited with respect to the shorelands because it

only regulates upland use, because the Harbour Commissions have direct powers to regulate shoreland structures, and because they are subject to Provincial land use regulation. The Harbour Commissions, however, have respected it with regard to upland use, and it is likely they will continue to do so.

A key purpose of the Plan was the need to provide certain services and facilities which were regional in nature and could not, or would not, be provided by the individual member municipalities. An important function was the provision of parks as it was noted, "several publicly owned major park sites appear likely to remain undeveloped because, understandably, the few municipalities involved cannot see why they should develop them largely for the benefit of the citizens of many other municipalities" (L.M.R.P.B.: 1963). However, the Plan has not recognized the capability of Fraser shorelands as recreation sites, or has seen shorelands as serving a more important use, and has designated the largest part of them for industrial use. If the District's outlook should change, the Plan can be amended by a two-thirds majority of member municipalities, and some small shoreland amendments have been made. No hearings are required. Although the amendments which have been made have not specifically been to establish parks, local park uses are permitted in those which have been redesignated as urban uses from industrial.

The eight municipalities adjoining the study area have considerable control over land use despite the limits placed over them by the Regional Plan and the provincial regulations

and federal agencies mentioned. Their control is by virtue of local zoning, control over land subdivision, and the power to enact building regulations. Although the blanket industrial designation is a severe restriction, the power to zone has still been quite important in that land could be retained for "lower order" use such as agriculture if development was not desired in certain areas. Control over subdivision is important in that it governs the area, shape, dimensions and alignment of land which has an impact on the type of land use and often the efficiency of shoreline use depending on the width of parcels created. An additional municipal power is in the extension of services which creates an effective development control.

C. SUMMARY

It has been demonstrated that private markets will tend to under-allocate Fraser shoreland to outdoor recreational uses because they do not reflect true preferences for these collective goods. Additional market imperfections were noted with the decreasing-cost nature of these facilities, with the inability of market prices to account for external effects, and with the bias towards present values.

Because of these market failures private industry has not provided recreation facilities in the study area and governments have had to intervene. The powers of several institutional bodies with authority to establish recreation facilities were reviewed, and numerous legislative avenues were found to be open

for this purpose. Although the Harbour Commissions, the most powerful agencies, are not specifically designed to overcome market failures and provide recreational areas, they have tended to follow the policies of the regional and municipal governments in this matter, and are likely to continue to do so.

Although several public agencies are empowered to establish parks and natural reserves it has been observed that very few of these have been set aside in the Fraser shorelands. It may be that the lack of action is a result of insufficient information as to the recreation potential and the industrial needs for Fraser shorelands. Because no systematic assessment has been made an evaluation of social opportunity costs would be very useful to local decision makers. This information could be useful to several bodies and the following analysis will not be directed at any one government agency.

Chapter Three

Potential Value for Recreational Purposes

The Fraser shorelands have been referred to as Vancouver's "other waterfront" in a recent newspaper article which pleaded for public action to save a portion for recreational and aesthetic pleasure (Leirin: 1973). This description is reinforced in discussions with community leaders and planners and it appears to be the outcome of a perception which has been characteristic throughout the Fraser's history. Hutchison, in his history of the Fraser, notes that "great moments on the river lacked a spectator who could give them permanent life" (Hutchison: 1950). However, evidence of a changing outlook has been cited at the outset and more will follow.

For a study of social opportunity costs of preserving shorelands in the Lower Fraser for recreation uses to be of practical value it must deal with specific sites. The purpose of this chapter is to identify the sites of potential value for recreational purposes. No effort is made to determine whether allocation of these lands to recreation purposes would in fact result in the highest and best use of shorelands.

A. RECREATIONAL LAND INVENTORY

In undertaking an inventory of potential sites along the Fraser it is useful to examine previous attempts in order to benefit from similar experiences in developing a methodology for gathering and organizing data. A review of the literature found it to be neither voluminous nor sophisticated, and many land resource inventories are littered with arbitrary standards and personal value judgements. Yet, it is all that is available at the current state of the art. The procedure followed, therefore, attempts to apply to the study area the better parts of known techniques. Following a review of basic terms, "land" and "recreation", the discussion examines the processes of inventory and evaluation, and outlines the methodology used.

The main interest is in land which can be used in its natural state, or with a minimum of modification. No attempt is made to consider potential areas for uses involving major construction such as tennis courts or marinas. Identification of a potential recreation area does not automatically imply that it should be developed as a regional or provincial park.

The term "land" is used to refer to a variety of natural resource attributes in a "...profile from the atmosphere above the surface down to some meters below the surface" (Stewart: 1968: 1). The particular attributes of a given parcel, such as climate, land form and vegetation, are fixed in location and extent and, therefore, must be exploited where they are situated. In order to assess the type, quantity and quality of each attribute a definable geographic unit is needed.

Several commentators have attempted to define recreation. Typical definitions include: "activity undertaken because one wants to do it" (Clawson: 1966), "pleasurable and constructive expenditures of leisure time" (Hills: 1961: 14), and "voluntary activity indulged in without external compulsion which results in the revitalization (or recreation) of body and mind" (Farina: 1961: 944). It would be fruitless here to pursue a more precise definition because of the highly subjective manner in which recreation is experienced. One additional qualification is to be kept in mind, however, and that is the outdoor nature of the activity. In this sense, only activities which are dependent on the physiographic and ecological characteristics of the land are of interest in this study.

Because no precise definition of outdoor recreation exists, it will be difficult to devise recreation resource analysis methods based on precise knowledge of the land resource needs of particular recreational activities. While the nature of a given land unit may suggest certain uses, there may still be a conflict of individual preferences. Peiluck (1967: 5) illustrates the dilemma well in the following passage: "Thus it is possible that a length of shoreline could be looked upon as a public campground by a government agency, a lucrative cottage subdivision by a private developer, and a wilderness area by a preservationist."

The failure to recognize the distinction between inventory and evaluation is one of the most common shortcomings of past attempts at resource analysis. The inventory stage essentially

consists of a series of objective measurements, while the evaluation stage generally involves an interpretation of the data in terms of specific land uses. If we consider a typical inventory variable such as topographic slope, a number of evaluation schemes have been applied in order to specify land capability for urbanization. Because the cut-off point for urbanization may range anywhere between 9 and 45 degrees, the selection and display of information must be done so as to indicate its evaluative nature. Numerous examples of past studies, however, lose sight of this distinction and incorrectly label their data interpretations as inventories. Thus Steinitz (1969) rightly concludes, it is usually not the data inventory, but the interpretation of the data which distinguishes methods. It is instructive to separate the processes involved in land resource analysis in order to clarify the matter further.

It will be useful to breakdown the process of land capability analysis into three distinct phases; these have been labelled as "individuation", "description" and "classification" by Conklin (1960). Individuation is the first stage because land exists in a continuous plane and must be broken down into identifiable units. Description is simply a listing or inventory of associated attributes, and classification involves grouping according to a set of critieria for what to recognize and what to ignore. The term classification as Conklin uses it is analagous to the term evaluation used here.

Two methods of individuation were considered. The first, which was used by the Canada Land Inventory, involves a

scientific breakdown of the landscape based upon climate and landform. Because this produced only very large land units, often encompassing several miles of shoreline, a second method based on the United States National Forest Recreation Survey (United States.: 1959) was adapted for the study area.

The Forest Service method was designed as a classification procedure for determining the existing and potential amount, kind, quality and location of recreation resources on land administered by the Forest Service. The first step in their procedure was to separate the landscape into two classes, each with a number of subclasses. In the first group, labelled "development sites", their subclasses were based on a number of landscape features which made an area amenable to such activities as boating, swimming and fishing. In their second group, labelled "dispersed recreation areas", they included wilderness areas, hiking areas and so on.

This approach can be readily utilized in the study area as two types of recreational use of shoreland became apparent in the initial fieldwork. The first is the development site type which is well suited to some specific recreational activity or sets of activites; these are renamed "major sites" for this study. The second type is the dispersed activities which are typically suited to scenic drives or walkways. Opportunities for recreational activities in the dispersed sites need not be confined to natural features in the sense that such man-made features as fishing docks or small boatworks are not inconsistent with the overall type of use. A third category

which is peculiar to the Fraser has been established, and it arises from the use of very small lookout points or sandbars, often at the ends of city streets, by the occassional picnicker or fisherman. These will be labelled "small sites" and dealt with separately.

Having developed a means of individuation based on three types of sites, major, dispersed, and small, the next phase is the inventory. Because discussions of inventory naturally lead into evaluation it will be necessary to discuss them together. A key issue to be resolved is whether land analysis should be undertaken from a morphological or a functional point of view. Commentators such as Christian (1959) argue that because land use problems and concepts of best form of land use change as the economy changes and more information is gained, it is highly desirable that resource analysis be based on the fundamental qualities of the land. Because these are independent of present knowledge of land utilization the inventory will be accurate at all points in time. Opponents argue that inventories need to be oriented to a set of specific uses in order to identify relevant resource attributes. Chapin (1965: 343) for example, states that resource inventories must be carefully tailored to the needs of the task at hand.

It is evident, therefore, that accuracy can best be assured if a strictly morphological approach is taken. However, some amount of functional evaluation is required in the choice of which land attributes are important to particular recreational activities if the resulting inventory is to be useful. Because

the exact needs of specific recreational activities are seldom clear, it is inevitable that some degree of subjectivity be present. Further investigation of procedures for evaluating the importance and quality of each resource attribute to specific recreational activities found that reliability decreased rapidly with attempts to increase specificity. The most common method of evaluation involves the use of point rating systems to assign weighting factors to each resource attribute, and multiplication of these by points assigned to indicate the quality of each. The final attribute totals are then cumulated to yield a capability rating number for a site which can then be compared with other sites. The main problem with using the rating numbers to compare sites is that different resource attributes at each location are compared according to an arbitrary scale. If the criteria for establishing the worth of each attribute are to be accurate, much more knowledge of user preferences than currently exists is essential (for a detailed review see Steinitz: 1970).

The conclusion of the investigation into methods of inventory and evaluation was that no well refined techniques have yet been devised, and the best approach for this study will be to confine the inventory to a general level. The Canada Land Inventory has been successful at this level and their approach can be easily modified for use along the Fraser. While the land was subdivided differently the inventory of capability can be conducted in a similar manner. The criteria for a number of possible recreational activities were used directly, and any omissions were filled by referring to studies by Belknap and

Furtado (1965), Brown (1971), and Lewis (1964). No attempt will be made to rank each sites capability, and the C.L.I. point system based on intensity of use will not be used. Modifications for each type of site mentioned will be introduced.

Most of the inventory work is confined to the development sites. The dispersed recreational sites will generally consist of areas suited to pleasure drives and a brief description will be made of each; the small sites will be given a similar descriptive treatment. The following will list the activities considered and describe the typical areas suited to each. It is important to realize that none of the categories is mutually exclusive, and that often the presence of one will markedly improve the capability for another (i.e., opportunities for beachcombing will enhance other beach activities).

Angling. Shoreland providing access to reaches of the river which are capable of sustaining sport fish. Factors to be considered are width and topography of foreshore or upland, depth, water quality, flow and bottom conditions.

Beach Activity. Shoreland which is level to moderately sloping and predominately made up of sand or till. The predominant use would be for sunbathing or picnicking. Generally the site would be of sufficient width to accomodate picnic tables and some amount of organized parking. In some cases, wide sections of upland may be included.

Boating. Shorelands where road access and water

conditions are suitable for launching small boats and canoes. Generally these will be transportable by hand rather than from back-in type trailers. A channel safe from turbulence, currents, or major shipping, as well as proximity to interesting islands or features, are factors.

Beachcombing. Shorelands which because of tidal or freshet conditions have tended to accumulate a good assortment of driftwood, or which possess rocks, minerals or vegetation that tends to attract curious beachcombers or hikers. Often these areas may be quite narrow and somewhat inaccessible.

Camping. Because of the urban nature of the waterway this activity will occur rarely. Generally it will have the same traits as the beach activity category, but with wider upland area suitable for construction of campsites.

Cultural Patterns. Shorelands exhibiting unusual or varied cultural landscapes. Examples may include fishing camps, settlement patterns, and farming activity.

Viewing. Shorelands which offer a prominent vantage point or good viewing opporunities. Wide expanses of natural scenery or interesting maritime commerce are typical sights to be seen.

Wildlife. Shorelands which provide an opportunity to either view from a distance, or actually move about in a wildfowl nesting area. Other natural flora or fauna

may also be considered.

Information for all classes of land unit was gathered by means of air photos, maps, previous studies, interviews with knowledgeable recreationists, and field observations on land and by boat. A list of sources is provided in Appendix I. In order to organize the information a checklist was devised for the development sites (see Appendix II). It was based on the criteria defined and on the survey conducted primarily on the upper reaches of the River beyond Barnston Island by McNab (1965). Generally, data were collected pretaining to site attributes, accessibility, current and potential recreational use, and conflicts with other uses. In using this information, it should be noted that the accessability information and conflicts identified are dynamic and, therefore, accurate only at the time surveyed.

B. INVENTORY RESULTS

If the general findings of the survey can be summarized in a phrase, it is that Fraser shorelands have a very good, though specialized, potential for recreational use. Generally, most sites lack the glamorous appeal of the mountanous North Shore, but they do have the capability to satisfy a large measure of local demand given improved access and the imaginative provision of recreational facilities. While waters are cold, frequently swift and turbulent, and unattractively muddy, they do have an appeal to many as evidenced by observed use during field studies

in the summer of 1973. The most active uses at present are bar fishing, picnicing and scenic drives.

(1) Major Sites

A number of specific observations can be made concerning these sites from a review of the information displayed in Table One. The locations of each can be seen in Figure Two.

Beginning with the information in the first six rows, the most common type of site combines some area of upland with foreshore. Generally, foreshore areas tend to be more important than upland, and in ten sites they were clearly the most important. Because the level of the tidal high water mark varies with the time of the year and the annual runoff, the actual usable area will vary. In most years the maximum exposed beach occurs in middle to late summer. Naturally, any physical development will have to be either portable (i.e., picnic tables) or above the high water mark; but, in most cases, only a minimum of improvement is needed beyond the provision of additional parking areas.

With the exception of five islands, four of which are accessible only by boat, most of the sites are accessible by road. As far as it could be determined the three sites which were not inspected by car were accessible by foot. In all cases where there were roads, at least some parking could be found even if it was only along a wide shoulder, and in all cases, there was sufficient space to increase the parking area. The assessment of the possiblity of accommodating additonal vehicles

was more important than originally anticipated because very few of the sites were near a large concentration of population which could easily walk to the river. As Table One shows, most sites were surrounded by agricultural, vacant, or industrial land. While proximity to residential areas (i.e., within walking distance) was only noted in three cases, this may be misleading because land near a number of sites may be developed for housing in the near future. Also, a large number of bicycle riders were observed during field studies.

The information on the use observed and interest expressed was included primarily to show the source of data. It is notable that in almost every case the site has been mentioned by at least one report or informant, or else use was actually observed during field studies. This would appear to suggest that concern has been fairly intense on the whole, but that it has only been directed towards the preservation of single sites rather than the overall recreation potential of the shorelands.

The remaining rows note the potential of each site to accommodate the eight activities listed earlier. Clearly the most important recreational pursuit is angling. Bar fishing was found to be important at all but three sites, and at seven sites it was found to be the only major activity. These corresponded almost perfectly with the sites identified as foreshore oriented. From discussions with fishermen it was concluded that almost every reach of the river offers some opportuity for fishing, and that fishermen will fish almost anywhere they can.

Beach activity was the next most important category with a

total of nineteen sites. These were usually in areas where suitable upland areas were available for the provision of picnic sites, play areas, washrooms and parking. Since most were also good fishing sites there is considerable scope for developing a number of parks which are suitable for picnickers, fishermen and sun bathers.

Boating was the third most important activity with a total of 17 suitable sites. Many of these sites are frequently used for launching small boats and canoes, and all contain gently sloping bars which are well adapted to their use. Because nine of the sites were not accessible by car, and five of these were islands, boating is the only means of access as well as an important activity. The islands were found to be easily approached by boat and generally suitable for angling or beach activity. There is considerable scope for improving some of them in order to accommodate the fast growing numbers of boaters in the study area.

The remaining categories were generally found to be supporting activities rather than primary uses. Beachcombing added considerable interest in a third of the cases, and notable cultural patterns were observed nearly as often. Opportunities for viewing were slightly more important and wildlife areas much less so. A noticeable tendency for some sites to monopolize these activities was noted, and in that sense sites 1,2,3,5,12,13,14,15,17,20,22,24,30,31, and 32 can be identified as key major sites within the study area. While all of the sites mentioned are considered to be important, these sites are

clearly identifiable as the most valuable. Interest has been expressed in all of them, they are suitable for beach activity, most are good fishing bars, and they all have some additional points of interest such as viewing or beachcombing.

(2) Dispersed sites

Because of the nature of the Fraser's recreation potential it was necessary to utilize this category for the descriptions of A to G shown in Figure Two. These areas do not represent potential linear park sites, but rather areas where attempts might be made to preserve the present character of their land uses so they might remain of interest to people on day outings like pleasure driving, cycling, hiking, or horseback riding.

Areas A, B, C, E, and G are similar in that they are in areas which are essentially agricultural or vacant. The road is located on top of a dyke for the most part, and is not suitable for fast driving. Fishing camps, abandoned docks, and the occasional boatbuilder are scattered along the way, and additional uses of this nature, as well as the occasional restaurant, fish or vegetable stand, or craftshop, could be allowed or even encouraged. These are basically in areas which are interesting because they contain a variety of activities, because they offer numerous opportunities for viewing the River, and because it is possible to gain access to the water in several places. Although all are suited to pleasure driving, they are all excellent cycling areas and several horseback riders were observed. In some cases it would be possible to construct seperate paths for these activities.

Area D, Barnston Island, will be mentioned separately because it rings an exclusively agricultural area and much of the outside of the dykes remains natural. The road is very popular with local cyclists who park their cars at the ferry dock, ride onto the car ferry, and cycle around the island. There are several opportunities to stop and gaze at the River, and the two major sites at either end of the island provide an opportunity for related activity.

Site F encompasses all of the estuarine islands and much has been said about preserving these. A detailed description can be found in Halladay and Harris (1972) and only the salient points need be repeated here. The largest and outermost are used extensively for agriculture as well as containing an important bird sanctuary. The area is used by several pleasure drivers, cyclists and nature observers. The smaller islands are covered by typical estuarine marsh with patches of trees, shrubs and grass, and they form a key waterfowl nesting area. Although some parts of these are dyked and farmed, they for the most part are natural and only accessible by small boat. The marsh area on the mainland is included because it is of a similar nature.

(3) Small Sites

Figure Two shows a number of small recreation sites but it is not in anyway comprehensive. There undoubtedly are several others, particularly in the dispered recreational areas, but the category was devised primarily to accommodate the proposals made to preserve several street end parks on the Vancouver side of

the North Arm. These are quite important in that area because most of the land is already occupied and they represent the last chance for public access to the Fraser . The main recreational attribute of these sites is the opportunity for viewing. Although picnic tables could be placed at some, and the occassional fisherman was noted during fieldwork, they are basically suited only for vantage points.

C. SUMMARY

An examination of the Fraser shorelands' potential value for recreational uses was conducted according to a methodology based on previous inventory approaches. Thirty-two major sites were identified, nearly half of which were found to be sufficiently atractive to merit reclassification as key major sites. Most of the sites are suited to beach activity but the most important use is for sand bar fishing. Another important use is for boating, and several sites are attractive for this use, particularily the estuarine islands. Several dispersed areas were found and these can accommodate numerous pleasure drivers, cyclists and walkers. The small sites were noted primarily as examples of ways of providing occassional access points for viewing River activity, particularily in built up areas.

The amount of shoreland which is of recreational value will be examined in detail in the next chapter which assesses conflicts. However, it is notable at this point that of a total

of 139.5 miles of shoreline in the study area (measured between the limits shown in Figure One), approximately 18.1 miles are suitable for major recreation sites. Because the amount of shoreland necessary for small sites is insignificant, and the amount necessary for dispersed sites is highly variable, no estimates were made for these sites. The amount of upland covered by major sites was crudely estimated at 2500 acres (assuming an average site width of 1500 feet and not counting the centers of large islands). However, this figure does not provide a true picture because the foreshore area at each site was frequently as large or larger than the upland (as shown from the survey). If it were possible to measure this intertidal belt the estimate of recreational shoreland area would be increased considerably.

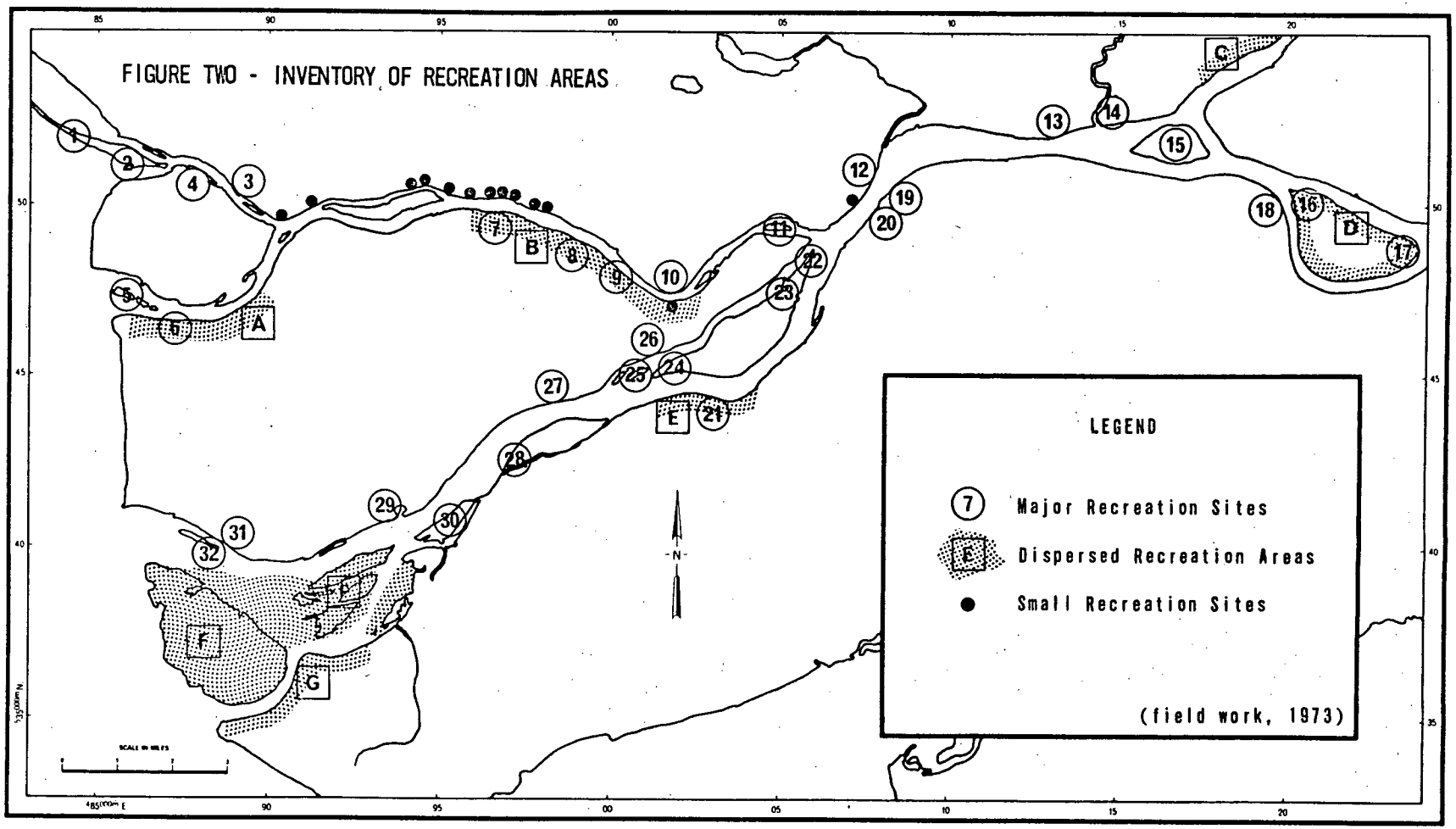


FIGURE TWO - INVENTORY OF RECREATION AREAS
LEGEND
7 Major Recreation Sites
E Dispersed Recreation Areas
Small Recreation Sites
(field work, 1973)
A
B
C
D
E
F
G
N

Table One

Recreational Use and Potential of Major Sites

(from field observation and sources in Appendix I)

MAP NUMBER>>	1	2	3	4	5	6	7	8	9	10	11
topography[1]	uf	uf	u	uf	uf	uf	f	f	fu	u	u
road access[2]	x	x	x	x		x	x	x	x	x	
parking possible[3]	x	x		x		x	x	x		x	
surrounding use[4]	iv	iv	rvi	rv	I	ar	iv	v	v	iv	I
use observed[5]	x			x	x	x			x		
interest expressed[6]	x	x	x		x	x	x	x	x		x
angling				x	x	x	x	x	x	x	
beach activity	x	x	x	x	x	x			x	x	x
boating		x	x	x	x						x
beachcombing	x	x									
camping											
cultural patterns						x					
viewing	x		x							x	
wildlife	x	x			x						
see notes	x	x	x	x							

1. u - upland most important; f - foreshore most important
2. assumes no private property restrictions
3. some parking space already and room for more
4. i - industrial, institutional; a - agricultural; r - residential; v - vacant; I - island
5. use noted during summer field investigation
6. area has been mentioned in a recent report or suggested by a recreationist

Table One (con't)

MAP NUMBER>>	12	13	14	15	16	17	18	19	20	21	22
topography[1]	u	uf	uf	uf	f	fu	fu	f	f	f	fu
road access[2]	x				x	x		x	x	x	x
parking possible[3]	x	x	x		x	x		x	x	x	x
surrounding use[4]	i	v	av	I	a	a	v	i	i	i	rv
use observed[5]	x					x					x
interest expressed[6]	x	x	x	x		x			x	x	
angling	x	x	x	x	x	x	x	x		x	x
beach activity	x	x	x	x		x				x	
boating		x	x	x		x	x			x	
beachcombing				x		x					
camping						x					
cultural patterns	x	x	x		x	x					x
viewing	x	x	x		x	x				x	
wildlife				x							
see notes	x			x	x	x				x	

1. u - upland most important; f - foreshore most important
2. assumes no private property restrictions
3. some parking space already and room for more
4. i - industrial, institutional; a - agricultural; r - residential; v - vacant; I - island
5. use noted during summer field investigation
6. area has been mentioned in a recent report or suggested by a recreationist

Table One (con't)

MAP NUMBER>>	23	24	25	26	27	28	29	30	31	32	TOT
topography[1]	fu	f	fu	fu	f	f	f	uf	fu	fu	
road access[2]	x	x			x	x	x	x	x		23
parking possible[3]	x	x			x	x	x	x	x		23
surrounding use[4]	i	vi	v	I	v	i	i	iar	ai	I	
use observed[5]		x			x	x		x	x		13
interest expressed[6]	x		x	x	x	x	x	x	x	x	25
angling	x	x	x	x	x	x	x	x	x	x	28
beach activity	x		x					x	x	x	20
boating		x	x	x				x	x	x	17
beachcombing	x		x	x				x	x	x	10
camping											1
cultural patterns								x	x		7
viewing	x		x					x	x	x	14
wildlife										x	5
see notes										x	

1. u - upland most important; f - foreshore most important
2. assumes no private property restrictions
3. some parking space already and room for more
4. i - industrial, institutional; a - agricultural; r - residential; v - vacant; I - island
5. use noted during summer field investigation
6. area has been mentioned in a recent report or suggested by a recreationist

Notes for Table One

Site 1. This is clearly one of the best sites in the study area; and it offers six miles of beach, the only sand dunes in the region, and the densest concentration of birds anywhere on the Lower Mainland.

Site 2. Before the construction of the Iona Island causeway Macdonald Slough was a part of the Sturgeon Bank estuarine area. Its separation has caused it to become a stagnant freshwater body with rapidly deteriorating water quality from extensive booming activities. The adjacent lands have recorded among the highest bird counts of anywhere on the Lower Mainland, and they are a key nesting area for the endangered Gadwell species.

Site 3. Vancouver City has expressed recent interest in developing this area between Angus Drive and Bernard Street as a waterfront park.

Site 4. Richmond's only foreshore park.

Site 12. The city of New Westminster has been interested in developing a waterfront park in this area for a number of years.

Site 13. Although the extraction of gravel from the Coquitlam River has affected steelhead and salmon runs, there is still reasonably good fishing where it joins the Fraser.

Site 15. Douglas Island contains one of the largest fresh water marshes in the lower mainland, and it is used extensively by Canada geese and several species of ducks. There are a number of bars scattered around the island which would be suitable for beaching a small boat or for bar fishing.

Site 16. There are ample sand bar areas to accommodate several fishermen.

Site 17. This is unquestionably one of the best potential recreation sites in the study area. Wide sandy foreshore and upland would be easily developed for day-use or overnight camping.

Site 21. This used to be one of the most well used fishing bars in the Lower Mainland.

Site 32. Access to this island is currently by a land bridge usable only at low tide. If a more serviceable foot bridge was constructed, the island could function as an excellent picknick site, fishing bar, vantage point and nature study area.

Chapter Four

Identification of Recreational-Industrial Shoreland Use Conflicts

The need for a clear understanding of the nature and extent of recreational-industrial shoreland use conflicts became apparent during the early stages of the study. The complaints of recreationists were varied and inconsistent, and preliminary investigation indicated that industrial use and needs for shoreland were complex and unclear. Indications were that the problem concerned the indiscriminate location of new plants rather than the total amount of shoreland absorbed by industry, but it was necessary to undertake a quantitative estimate of the precise nature and extent of the conflict in order to develop and apply a methodology for the evaluation of social opportunity cost.

Two main types of conflict can be identified: those which involve permanent use for factory sites or related industrial activity, and those which involve non-permanent uses such as log booming. This chapter will estimate the amount of conflict with major recreation sites, and the amount and type of vacant industrial land along the River. Conflicts with dispersed sites

and small sites will also be mentioned. It will be necessary to begin by describing briefly the existing use of shorelands.

A. NATURE OF INDUSTRIAL USE

Shoreland use can either be in the form of fixed structures which occupy upland and foreshore sites; or it can be in the form of portable water lot and foreshore use for log storage which influences other uses of upland and foreshore sites. Beginning with the former, it was observed in Figure One that shorelands are essentially vacant or agricultural in aspect. Subsequent measurement on large scale maps revealed that only 40 of 139.5 miles of study area shoreline is occupied by some type of industrial, commercial, or residential activity. Of the used length about 24 miles are occupied by significant industrial operations, while the remainder is characterized mainly by less intensive commercial-industrial activities such as fishing sheds or small marinas. In other words only about 17% of the study area's shoreland is currently occupied by sawmills, gravel storage, food processing plants or similar sized industrial activities.

The forest industries use of foreshore and adjacent water areas is by far the most important consideration under this heading. The geography of the coastal forest industry has been strongly influenced by the the coastal waterway and the Fraser River because of the need for an economical means of transporting logs. Most of the major mills are centered in the

Greater Vancouver area, while timber is harvested at various points along the coast. Logs are towed in booms, 66 feet wide by 66 feet long and usually one log thick, and stored in the water until needed. While the Fraser offers the key advantage of fresh water protection from marine borers, its strong tidal and freshet currents limit the times and seasons when logs may be brought into the River, and consequently a large inventory must be maintained upstream from the mills. Additional storage needs are also added by seasonal interruptions in supply brought on by very dry summers or heavy snowfall. Another consideration which has evolved because of the availability of water lots for storage has been that these locations facilitate trading of different species and grades of timber among mills. Under existing timber tenure regulations mills may only process the quantity of logs harvested from their particular tree farm licences, but these need not necessarily be the same logs as they cut in their own camps. In order to facilitate specialization among mills, they may trade equivalent quantities of logs among themselves. The Fraser, therefore, has provided not only the means of transport, but also a place for extensive year-round storage to accommodate seasonal variations and mill specialization.

B. CONFLICTS WITH PERMANENT INDUSTRIAL USE

Because much of the Fraser shorelands are unused, it might appear that land could be readily set aside for recreational uses. Local planning authorities, however, have not shared this

perception; instead they have managed Fraser shoreland with the assumption that all waterfront sites should be reserved for industries that exhibit a waterfront orientation. The assessment of conflict, therefore, will begin by identifing which of the major recreation sites are located in areas designated for industrial use by the Regional Plan. While this document controls all land use in the study area, other factors govern the suitability of shoreland sites for industrial occupation. These include channel depth, foundation conditions, and services available. However, while these factors are important regardless of the official designation, they were only examined in the areas designated industrial for purposes of the social opportunity cost evaluation.

(1) Regional Plan

The Regional Plan regulates all land use, and any violation thereof constitutes a violation of the Municipal Act. Of the five types of development areas -- industrial, urban, rural, park and reserve -- industrial clearly is allocated the largest portion of the shoreland, as Figure Three demonstrates. Recreation site conflicts with other designations were not considered because of the small amount of land involved, because park areas are permitted within areas designated urban, and because rural agricultural uses generally do not involve restricting access to, or building permanent structures upon the sites identified. In the areas designated industrial the only activites permitted are industrial plants, interim rural uses, and transportation uses.

The Plan has been altered by amendments and by the Provincial Government, and these changes will have to be noted before proceding to the identification of conflicts. The impact of municipal zoning is also important in that it effects the interpretation of the Plan. First, the Plan has been altered by a few amendments since 1966. Although Figure Three and all of the following calculations reflect the amendments as they concern the shorezone, none of the conflicts identified were in areas directly affected by them.

Second, the Provincial Government has, through the Land Commission Act, designated a number of areas as agricultural land reserves. Areas possessing fertile soils have been designated primary reserves, and only agricultural and transportation uses are permitted. Because the Regional Plan and local zoning must abide by the Act, Figure Three and the following calculations have been modified accordingly. The only area directly affected is Barnston Island where sites 16 and 17 are located. The Act also sets aside a number of secondary reserves in less fertile areas. These lands are temporarily restricted to agricultural reserves but no final decisions have yet been made concerning their use. The recreation sites which may eventually be affected when current studies of these reserves are completed are noted in the identification of conflicts.

Third, local zoning can have an important influence on industrial use, but a review of local zoning bylaws found them to vary little from the Regional Plan. Although slightly less

shoreline has been zoned for industrial use, only site 31 is zoned out of industrial use. Because of this similarity, and because of the relative ease with which municipal zoning may be altered (the Regional Plan requiring a two-thirds majority vote), local zoning was not considered in the assessment of conflict.

The amount of conflict between major recreation sites and the Regional Plan has been identified in terms of miles of shoreland, and in terms of acres of industrial land. Because very little upland area is required by major sites the former is most important and three tables have been devised to display the information. Table Two summarizes the main conflicts identified in terms of shoreline miles. The actual conflict at each major site and a detailed evaluation of conflicts with varicus types of shoreland are presented in Tables Three and Four, respectively, which appear at the end of this chapter.

a. Miles of Conflict

From the identification of conflicts in Table Three it can be seen that 23 of the 32 major sites are located in areas designated idustrial. Three of the dispersed recreation sites were also affected. The summary in Table Two indicates that preserving all of the major sites for recreation would involve the loss of 9.6 miles, or 16%, of the region's vacant shoreland designated industrial.

Table Two

Summary of Recreation-Industrial Shoreland Conflicts (Miles)

SHORELAND POTENTIAL AND USE	NORTH ARM	MAIN ARM	TOTAL
	miles (%suit. for major sites)		
vacant designated industrial	18.5 (7)	41.3 (20)	59.8 (16)
-shallow port	18.5 (7)	15.8 (18)	34.3 (12)
-good-fair foundations	11.0 (8)	12.0 (9)	23.0 (9)
-deep port oriented	0	7.3 (10)	7.3 (10)
-good-fair foundations		3.3 (3)	3.3 (3)
-deep port/port oriented	0	18.2 (34)	18.2 (34)
-good-fair foundations		14.0 (40)	14.0 (40)

b. Acres of Conflict

It is impossible to specify accurately the total area of industrial land that would be involved if all of the major sites were preserved because it is difficult to estimate the width of the recreation sites identified. However, because the removal of a large amount of the regions land designated industrial could have significant effects on the land market a rough estimate was made.

In 1966 there were about 18,300 acres of land designated industrial in the G.V.R.D. (calculated from G.V.R.D.: 1971). However, of this only 12,500 acres were considered suitable for immediate use by Space for Industry. The remainder was considered suitable only for future expansion. Since then the Land Commission has removed about 2500 acres from the total for

primary agricultural reserves. Industrial expansion has taken up an additional 1800 acres to 1972 (calculated from Levesque: 1974). Subtracting out the new expansion and the primary reserves we are left with about 14,000 acres of vacant land designated industrial , and 8200 acres of land considered to be suitable for immediate use.

An estimate of the land area required for major recreation sites was made for each site within the industrial designated region. Assuming a liberal site width of 1500 feet, and discounting small islands not included in the above totals, it was found that about 500 acres would be needed. This total only includes the upland area of sites as the foreshore is not included in the totals above. While 500 acres may appear to be a low estimate for the number of sites involved, inclusion of the foreshore, as the previous chapter indicated, would increase the estimate of actual usable major site acreage considerably.

Comparing the area of major sites with the total acreage of industrial land in the region, it was calculated that about 4% of the vacant land would be needed if all of the major recreation sites were preserved. Similarily about 6% of the vacant immediately suitable land would be required for major sites. Therefore, on the basis of these calculations it is safe to say that major recreation sites conflict with about 5% of the region's total supply of land designated industrial.

Because this total proved to be small it will not be necessary to break it down further, in terms of area, in the subsequent examination of channel suitability and foundations in

this chapter. However, it will have to be considered as a factor in the evaluation of social opportunity cost.

(2) Channel Characteristics

The main concern of waterway users seeking shoreland sites is likely to be the suitability of the waterway for their particular type of use. The potential conflict between these uses and recreation sites was assessed in terms of channel characteristics. Figure Four illustrates the suitability of areas designated industrial for port or port oriented industry requiring deep water, port oriented industry requiring deep water, and port oriented industry requiring shallow water ("port" industries are largely engaged in deepsea shipping, and "port oriented" industries require waterfrontage either to bring in supplies or to ship finished products).

The criteria for classifying shorelands according to these categories were taken entirely from a recent study by the G.V.R.D. (1971). Generally speaking areas shown as suitable for port or port oriented industry will be able to accommodate vessels with a draft of up to 33 feet on a 12 foot tide and, with the current dredging program, up to 35 feet within three years. The maximum depth possible with further dredging is limited to 40 feet because of the Deas Island Tunnel. The port oriented industry category generally applies to areas having a depth range from 20 to 33 feet. Shallow water industrial areas may contain as little as 10 feet, but generally range as high as 15 feet. In the North Arm a dredging program is aiming at this higher mark as a uniform minimum depth within the next two to

three years. Further dredging is unlikely, however, because of high costs and problems of bank erosion.

Table Three shows the channel characteristics of each site. Although shallow draft occurs more frequently in terms of total numbers of major sites, a larger number of key sites are found in deep draft areas. However, in Table Two a more distinguishable conflict with port and port oriented use is readily observable. Of a total of 28.2 miles of shoreline in this category the recreation sites occupy about 22%; and of the vacant shoreland in this group they occupy 34% of 18.2 miles. The second most important conflict is with vacant shallow draft use with about 12% of a possible 34.3 miles involved. Most of this is accounted for by the Main Arm as only 7% of the land in this category is affected on the North Arm. Major recreation sites conflict with only 10% of the land in the deep port oriented industry category.

(3) Foundation Conditions

Another factor which is typically considered as important to the location of industrial plants is the foundation condition. Because many Lower Mainland areas are noted for their very poor foundations much attention has been paid to this aspect of land use. The most detailed investigation of foundation conditions can be found in Dynamics of Industrial Land Settlement (L.M.R.P.B.: 1961), and Figure Five is drawn from its findings. Based on this report all shorelands can be classified into one of four categories: (1) no extra costs normally involved, (2) no extra cost or capable of successful treatment at moderate cost,

(3) extra cost not known but likely to be moderate to high, (4) extra costs likely to be high. However, on the basis of observed use of Fraser shoreland it became evident that patterns of industrial use did not closely correspond to their outline, and measurement indicated that 28% of all occupied shoreland was in category (3) and (4) areas. The largest part of the use has occurred in category (4) lands in the Surrey and Delta sections. Based on this observation, therefore, it was decided to utilize only two categories, good to fair and poor to very poor, for analysis.

Table Three shows the foundation conditions at each site, and the amount of conflict is summarized in Table Two. As it can be seen major recreation sites conflict with areas having good foundations primarily in the port and port oriented industry category. Of a total of 14.0 miles of this type of shoreland, 40% would need to be removed to preserve major recreation sites.

(4) Other Considerations

A number of other factors influencing new industrial locations were examined but not found to be worthy of extensive treatment. The first of three was access to other transportation facilities, namely road and rail. Because of the dynamic nature of these facilities it would be difficult to make a meaningful estimate of the shoreland areas having access to them, and the percentage of these classified as recreation sites. It is fair to say that the largest portion of study area shoreland can be reached by road, and substantial parts by rail

as well, and that recreation sites do not occupy a disproportionately large amount of these areas. Based on Table Two it would probably be more correct to say they occupy a proportionally smaller length of road or rail serviced shoreline.

Sewer and water service, the second factor, is less available than transportation, but its dynamic nature also limits the usefulness of estimates. In addition it was found that many firms have the ability to be largely independent of these services, and a study by Swan-Wooster Engineering (1972) for a major industrial plant locating on unserviced land indicated that firms could provide their own well water and sewage treatment at a moderate cost relative to the total investment.

The third factor considered was land tenure. It was found that upland portions of most of the major sites were located on private property; foreshores are owned either by the Province or the Harbour Commissions; and adjacent water was owned by the Federal Government. Because of this complexity, and because ownership of private property can change very quickly, no meaningful estimates of conflict can be made in this regard.

C. CONFLICTS WITH NON-PERMANENT INDUSTRIAL USE

Figure Six illustrates the extent of log storage activity on the Fraser, and Table Three shows the major recreation sites where booming conflicts. It can be seen that a conflict was noted at 24 sites, 11 of which were key sites. For each site an approximate estimate was made of the minimum storage area that would have to be removed in order to accommodate recreational use. It must be stressed that these estimates do not reflect the total storage area that may lie adjacent to a site, they only reflect the minimum necessary to reduce the conflict sufficiently to accommodate recreational use. Their main value is for the purpose of deriving a total in order to estimate the proportion of the total storage area involved, rather than as precise estimates at a site level. It will be noted that in some cases a conflict was listed in Table Three but the estimate shown is zero. At these sites it may be preferable to eliminate some storage area, but not essential.

Table Four shows that it would be necessary to move 6% of the total storage area in the North Arm and 9% in the Main Arm in order to free all of the major recreation sites. In total this amounts to approximately 8% of 1700 acreas of storage space.

A note of qualification about the interpretation of conflicts with log booming is warranted at this point. The calculations have deliberately been confined to the minimum needed to free the recreation sites in order to facilitate uses requiring direct water contact (eg. fishing). The total area

which may appear to conflict may be larger but much disagreement has been found over the aesthetic merits and demerits of log booms. While the host of the reports consulted in the previous chapter condemn booming completely, others have extolled the beauty and virtue of log booms. To quote Hardwick (1961) for example: "The order of the boom, the massiveness of the boom, the realization that thousands of years of living trees are assembled, then moved for man's use to some processing establishment - all make log booms fascinating and even romantic to the coast dweller."

A few special situations were observed during fieldwork where use of upland could be altered or relocated to facilitate recreational use. Site 20, a scrap yard, is an important example. It makes no use of river frontage, and no permanent industrial works have been constructed. It is simply used for the storage of old car bodies. Other cases are listed in the notes to Table Three where an upland owner makes little or no use of the recreation site in question but controls access to it. Use of these sites for recreation would involve the provision of an access corridor and suitable fencing to facilitate recreational use.

D. SUMMARY

The information generated in this analysis will be used to provide a specific frame of reference within which the following chapter will consider the opportunity cost of preserving major, dispersed and small recreation sites. Two main types of conflict have been identified which affect the use of major recreation sites in the Fraser shorelands.

In the first case involving the construction of permanent industrial facilities, it was found that most of the major recreation sites have been designated for industrial use by the Regional Plan, and the most important type of shoreland affected was that having deep draft port and port oriented industry potential and good foundation conditions. In order to preserve the major recreation sites it would be necessary to forgo shoreline in each of the following categories: 12% of the shoreland suitable for shallow port industry, 10% of the shoreland suitable for deep port oriented industry, and 34% of the shoreland suitable for port and port oriented industry. Because some of the major sites occupy lands having good foundations, the possible removal of lands having good foundations will have to be considered in the evaluation of opportunity cost. The extent of this problem was summarized in Table Two. Because of the nature of the small and dispersed sites, conflicts with these have only been mentioned briefly.

The second type of conflict noted largely concerned the use of shorelands for log storage. Because of the uncertainty involved in estimating the extent of this conflict percieved by

recreationists it was decided to estimate only a minimum limit of the storage area that would need to be relocated to accommodate recreationists. In this case it will be necessary to calculate the cost of relocating approximately 8% of the total storage area.

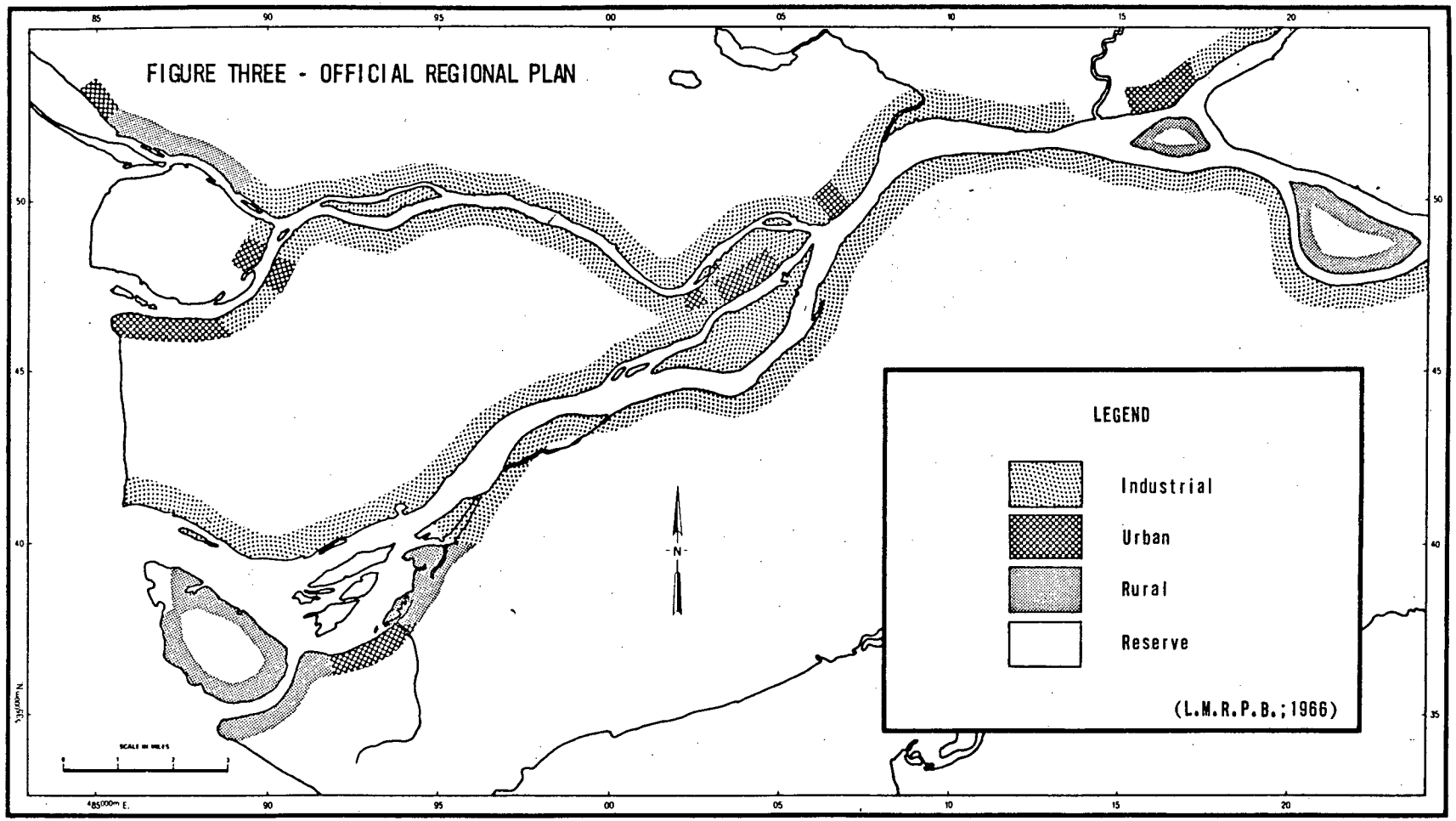


FIGURE THREE - OFFICIAL REGIONAL PLAN
LEGEND
Industrial
Urban
Rural
Reserve
(L.M.R.P.B.; 1966)
N
85
90
95
00
05
10
15
20
50
45
40
35

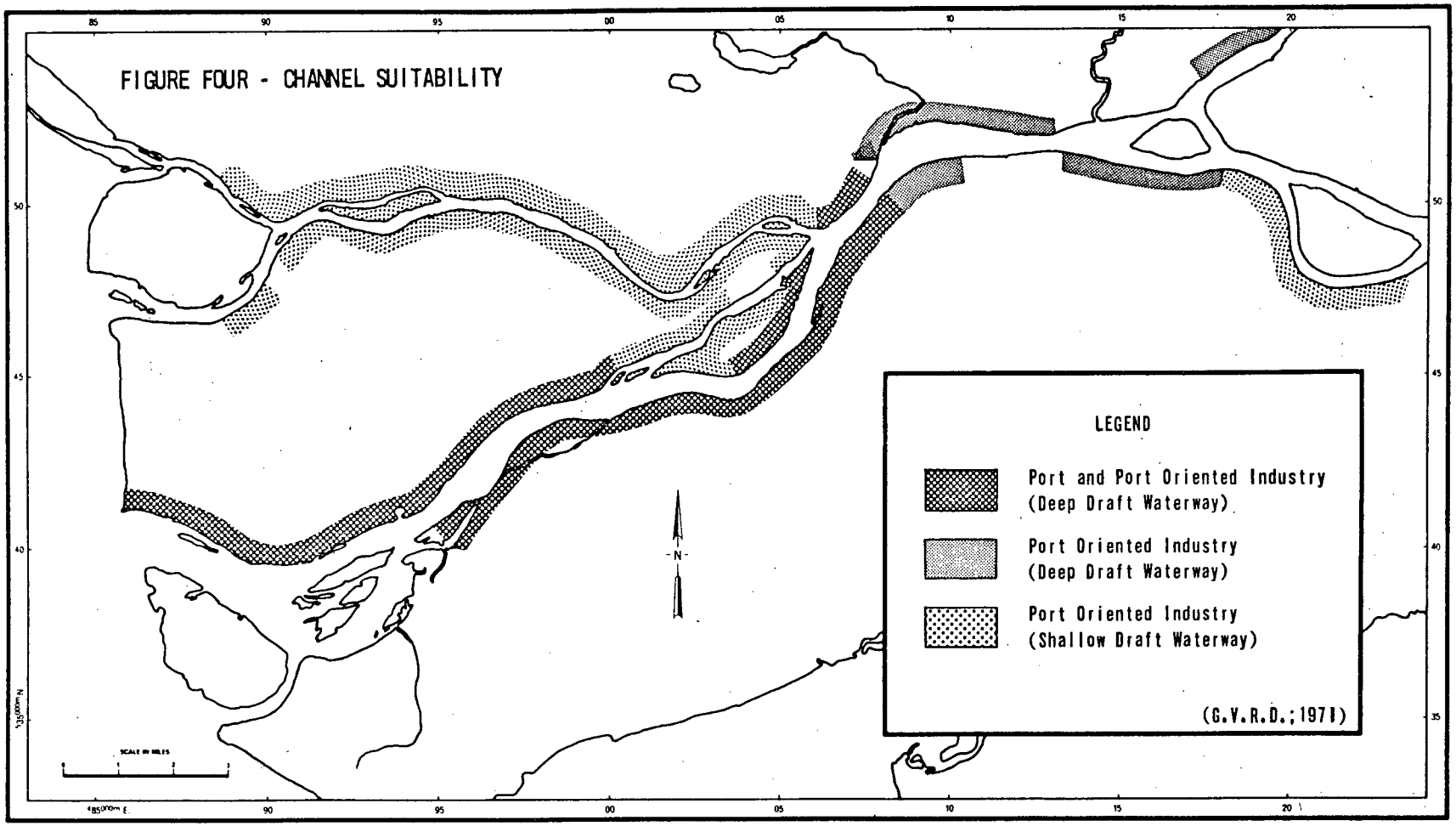


FIGURE FOUR - CHANNEL SUITABILITY
LEGEND
Port and Port Oriented Industry
(Deep Draft Waterway)
Port Oriented Industry
(Deep Draft Waterway)
Port Oriented Industry
(Shallow Draft Waterway)
(G.V.R.D.; 1971)
N
85
90
95
00
05
10
15
20

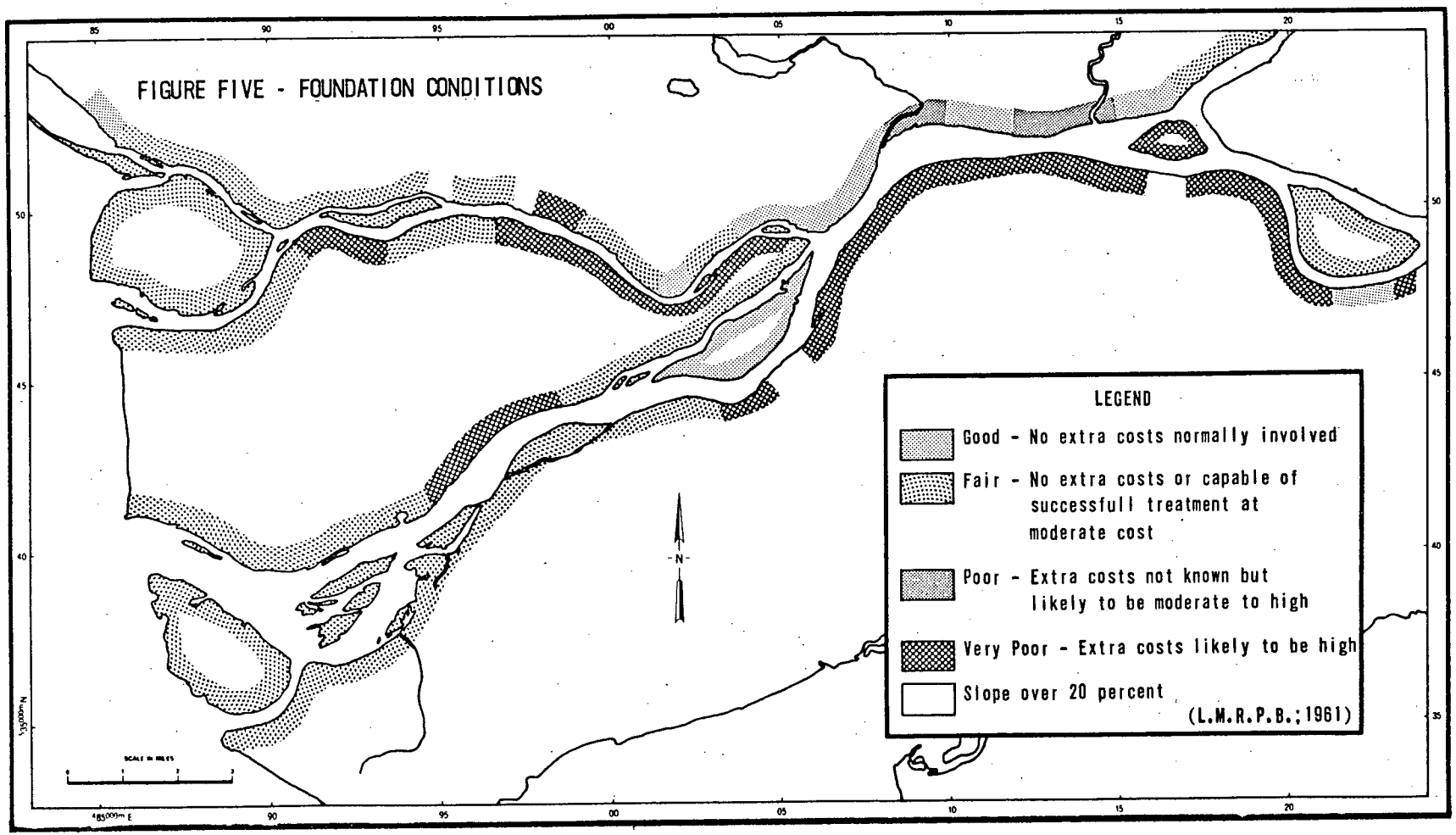


FIGURE FIVE - FOUNDATION CONDITIONS
LEGEND
Good - No extra costs normally involved
Fair - No extra costs or capable of successfull treatment at moderate cost
Poor - Extra costs not known but likely to be moderate to high
Very Poor - Extra costs likely to be high
Slope over 20 percent
(L.M.R.P.B.;1961)
N
85
90
95
00
05
10
15
20
50
45
40
35

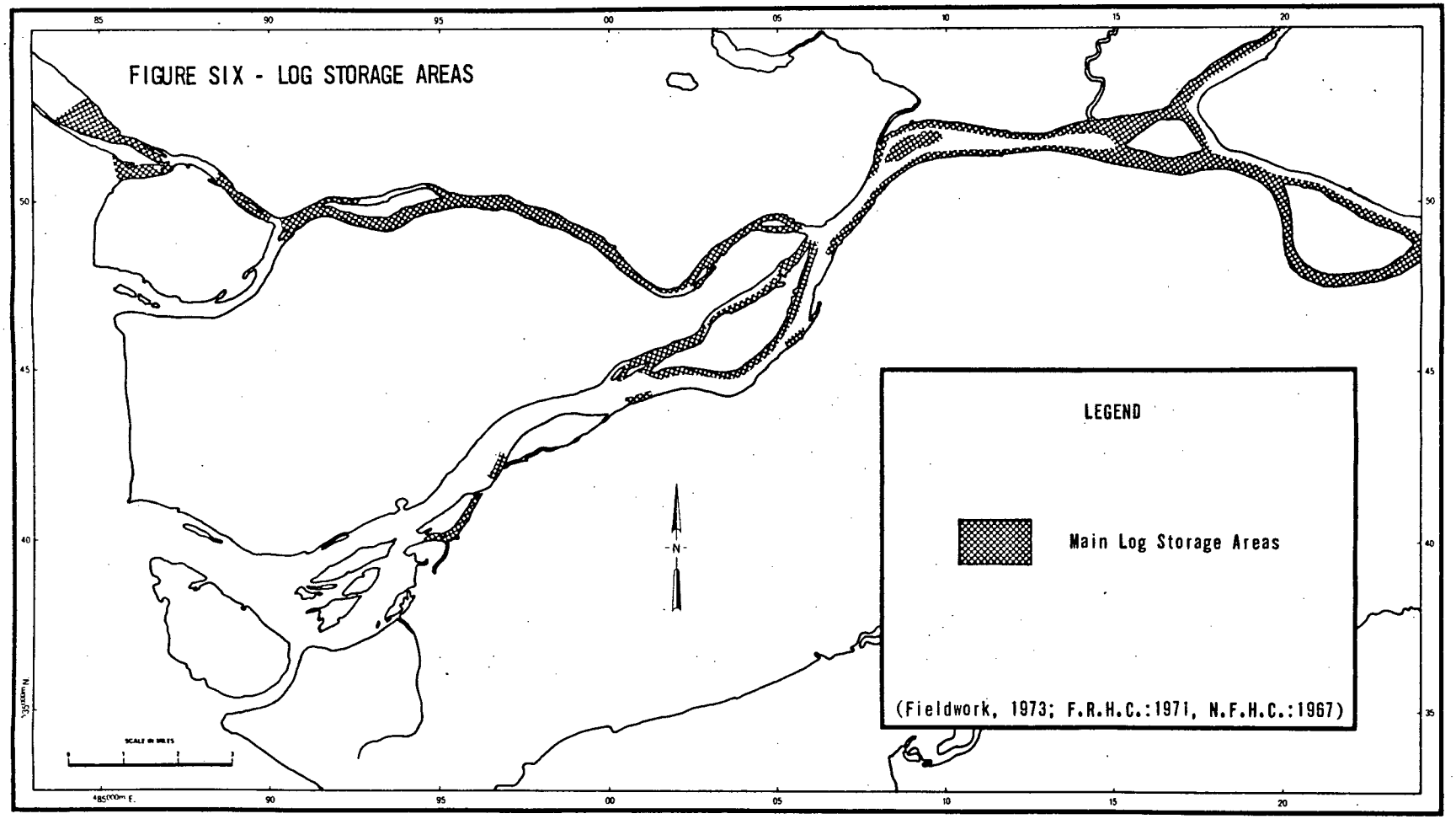


FIGURE SIX - LOG STORAGE AREAS
LEGEND
Main Log Storage Areas
(Fieldwork, 1973; F.R.H.C.:1971, N.F.H.C.:1967)
N

Table Three

Potential and Existing Conflicts

SITE NO.	APPROX. SHORE. FOOTAGE	REGIONAL PLAN CONFL.	FOUNDATIONS AT SITE	CHANNEL SUIT. AT SITE	BOOMING CONFL.	STORAGE ACRES CONFL.[2]	OTHERS -SEE NOTES
1	4600				x[6]	6	x
2	10000				x[6]	15	x
3	1200	x[3]	fair	shal.	x	4	x
4	1000						
5	2400						x
6	900						
7	300	x[3]	v.poor	shal.	x	1	
8	200	x[3]	v.poor	shal.	x	0.5	
9	1500	x[3]	v.poor	shal.	x	3	
10	600	x	good	shal.	x	1.5	
11	3000	x	fair	shal.	x[6]	2	
12	800	x	good	deep[4]	x[6]	0	
13	2000	x	poor	deep[4]	x	7	
14	2000				x	6.5	
15	19000				x[6]	5	x
16	1000				x	5	x
17	2000				x	9	
18	1500	x	v.poor	shal.	x	8	
19	900	x	v.poor	deep[4]	x[6]	0	x
20	900	x	v.poor	deep[5]	x	2	x
21	1000	x	fair	deep[5]			
22	1000	x	good	deep[5]	x	6	
23	600	x	good	shal.			

Table Three (con't)

SITE NO.	APPROX. SHORE. FOOTAGE	REGIONAL PLAN CONFL.	FOUNDATIONS AT SITE	CHANNEL SUIT. AT SITE	BOOMING CONFL.	STORAGE ACRES CONFL.[2]	OTHERS -SEE NOTES
24	2000	x	good	shal.	x	5	
25	2500	x[3]	fair	shal.	x[6]	0	
26	700	x	fair	shal.	x	1.5	
27	2000	x	v.poor	deep[5]			x
28	1500	x	fair	deep[5]	x	4	
29	600	x	fair	deep[5]	x	3	x
30	15000	x[3]	fair	deep[5]	x[6]	33	
31	3600	x[3]	fair	deep[5]			
32	7200	x	fair	deep[5]			
A	14000						
B	20000	x	v.poor	shal.	x[6]	0	
C	7000	x[3]	fair	deep[4]	x[6]	0	
D	33000				x[6]	0	
E	14000	x	v.poor	deep[5]	x[6]	0	
F	N.A.						
G	12000						

key major recreation areas
x indicates conflict
1. indicates approximate minimum length that would have to be forgone in order to accomodate recreaticnal needs
2. indicates approximate minimum storage area that would have to be forgone in order to accomodate recreational use
3. upland has been designated secondary agricultural reserve
4. port oriented industry only
5. port or port oriented industry
6. denotes only a partial conflict

Notes for Table Three

Site 1. A light industrial park has been proposed for this site.

Site 2. This is a particularily difficult area to estimate the log storage area conflict.

Site 3. There have been various proposals for light and heavy industrial development at this site.

Site 5. The conflict in this case was with barge storage rather than log storage but it was treated in the same way for simplicity. The estimate represents the log storage area that would have to be forgone in order to accomodate the barges if the site was given over to recreation use.

Site 15. While the entire island is ringed with log booms it would only be necessary to remove a few to improve the recreational capability.

Site 16. Access to this site is restricted because of the location of a farmers yard and buildings.

Site 19. Use of upland area for gravel storage prevents access to a formerly popular sand bar fishing site.

Site 20. Use of the upland and foreshore area by a scrap metal dealer has eliminated access to one of the most popular sand bars in the area.

Site 27. Access to this site is difficult because a permit is necessary to cross the Richmond Dump. The dump has made it a very dirty and unpleasant site, but it has still remained popular among fishermen.

Site 29. Access to this site is restricted by the upland owner.

Table Four

Extent of the Recreational-Industrial Conflict[1]

SHORELAND POTENTIAL AND USE	NORTH ARM	MAIN ARM	TOTAL
	miles (%indust. designated)		
major recreation sites	4.9 (27)	12.8 (65)	17.7 (54)
key major recreation sites	3.5 (6)	10.5 (59)	14.0 (46)
	miles (%suit. for major sites)		
total shoreline	48.5 (10)	91.0 (14)	139.5 (13)
vacant or agricultural	31.3 (16)	68.2 (18)	99.5 (18)
designated industrial	31.6 (4)	60.0 (14)	91.6 (10)
-shallow port	31.6 (4)	20.4 (8)	52.0 (5)
-deep port oriented	0	11.4 (6)	11.4 (6)
-deep port/port oriented	0	28.2 (22)	28.2 (22)
vacant designated industrial	18.5 (7)	41.3 (20)	59.8 (16)
-shallow port	18.5 (7)	15.8 (18)	34.3 (12)
-good-fair foundations	11.0 (8)	12.0 (9)	23.0 (9)
-poor-v.poor foundations	7.5 (5)	3.8 (8)	11.3 (6)
-deep port oriented	0	7.3 (10)	7.3 (10)
-good-fair foundations		3.3 (3)	3.3 (3)
-poor-v.poor foundations		4.0 (15)	4.0 (15)
-deep port/port oriented	0	18.2 (34)	18.2 (34)
-good-fair foundations		14.0 (40)	14.0 (40)
-poor-v.poor found		4.2 (12)	4.2 (12)
	acres (%conf. with major sites)		
log storage area	600 (6)	1100 (9)	1700 (8)
	acres (%conf. with key m. sites)		
log storage area	600 (4)	1100 (7)	1700 (6)

1. The length of shoreline was measured on large scale maps but several factors limit its accuracy. These mainly include the shape and amount used of occupied lots, and a number of firms which located too near to the shore to permit another industrial use, but which did not actually occupy the immediate shore area. Islands were generally measured if they were not innundated during high runoff years, but the long narrow ones were only measured along one side because they could not accomodate industrial activity on both sides. The limits of the shoreline measured are shown in Figure One. Estimates of log storage areas were taken from Harbour Commission maps and Forward (1968), and their accuracy can only be claimed tc be sufficient for such purposes as they were used here.

Chapter Five

Analytic Framework for Examining the Social Opportunity Cost of Preserving Fraser Shoreland for Recreation

Chapter Two concluded that there may be some serious shortcomings in the way that present institutional arrangements allocate shoreland. Whether new arrangements are needed is difficult to say, but it is clear at least that better evaluation techniques are required for improved shoreland allocation decisions. Chapter Three identified a number of recreation sites which may be worthy of preservation, and Chapter Four identified the main conflicts between the sites and potential and existing upland use. The purpose of this Chapter is to set out a framework in which the social opportunity cost of preserving these sites for recreation can usefully be examined.

Ideally, an analytic technique should be able to assess all the benefits and costs of alternative land uses. It would, in other words, perform the same role as a well-functioning market in allocating the land to its best use. To undertake a benefit-cost analysis, the most commonly employed framework, to determine the best use of major recreation sites identified, it

would be necessary to impute a value to unpriced recreation benefits. There are techniques for making such an evaluation that have been applied successfully elsewhere, but primarily in situations where the recreationists could easily be identified and questioned. The current use by recreationists on Fraser shorelands is far less than that which could easily be accommodated and thus the argument for preserving the sites rests more on expectations of future demand.

Future demand is closely linked to the perception of supply and a change in designation of the land plus the provision of suitable facilities will undoubtedly have a major influence on the demand for recreation on the Fraser shorelands. But this is exceedingly difficult to predict accurately. Given these difficulties this thesis seeks to provide an alternative approach which tries to illuminate the key elements which should be considered in a shoreland allocation decision. The approach adopted is to examine the opportunity cost of allocating shorelands to recreational use. In particular the perceived assumption that there is a scarcity of shoreland for industrial purposes will be scrutinized to assess the implications of removing some of the land from its industrial designation.

The opportunity cost approach asks the question, what in fact is given up by allocating land to one use as opposed to another. Because shorelands are considered to be valuable to industry by the Regional Plan, this suggests that many firms may attach a rental value to shoreland in excess of the rental value which they attach to upland sites with similar foundation or

servicing features. This analysis will attempt to evaluate the nature and size of the rental difference in qualitative terms, project the future needs of firms which require shoreland, and compare these needs with the supply of land designated industrial.

This analysis will not, of course, answer all the questions a decision maker wants answered. For example, it will still be necessary to make a judgement about whether the recreation benefits generated by Fraser shorelands exceed the opportunity cost of so allocating the lands. But knowing first something of the opportunity cost makes this judgement much more manageable.

A. EVALUATING SOCIAL OPPORTUNITY COST: A REVIEW OF PERTINENT THEORETICAL AND EMPIRICAL LITERATURE

The evaluation of social opportunity cost will be concerned with the demands placed on shorelands by industry, and the ability of the supply of vacant lands to absorb these. As it has been pointed out the supply of vacant shoreland can be assessed in terms of miles of waterway access and in terms of land area. Because the main conflict identified was with the miles of waterway access which are required for recreation this will be the central concern. However, a small amount of the region's land designated industrial would also have to be forgone in order to preserve recreation sites and this will also be of interest. An evaluation of the opportunity cost of log storage alternatives will be approached from a different point

of view in that the costs of three alternatives will be examined in pecuniary terms. Any additional costs imposed by changing to other means or areas for storage will be referred to as opportunity costs.

A major aspect of the analysis concerns the demands placed on shorelands for waterway access. Because different firms require different combinations of land resource attributes they attach particular values to such features as foundations, proximity to central business areas, utility servicing, waterfrontage and ground transportation facilities. The importance of certain combinations of these attributes can be termed a rental value. This rent does not equal the amount actually paid to use the land, or the amount that can be imputed from market value data. But rather it reflects the amount a user could pay for the land because of the net product he gets from it. Because shorelands may hold a particular rental value for some firms it will be important examine this factor in detail.

However, it may not be the only consideration and the literature on industrial location was consulted to provide an overview of its relative importance. With this understanding the discussion will proceed to a review of methods of evaluating the social opportunity cost of limiting the development of certain lands. The final section will describe the analytic techniques which will be applied to the study area.

(1) Factors in the Rental Value of Shorelands

a. Access to Waterway Transportation

The desire of firms to minimize transportation costs has been the central theme throughout much of the literature on industrial location. Because waterway transportation is the cheapest means of moving goods, particularily heavy goods over great distances, it is generally assumed that firms will automatically choose it wherever possible. This thinking has characterized much of current theory which was founded by Weber (translated in Friedrich: 1965) at the turn of the century. Although more recent writers (eg. Hoover: 1945 or Alonso: 1967) have developed more complex analyses which incorporate many additional variables, they have not strayed from the original "least-cost" principle.

In order to review the current applicability of this approach and the importance of access to waterway transportation it will be necessary to consider its significance to interregional and intraregional location decisions. The former deals with the means an industry chooses to locate in a region, and the latter with where it locates within a given region. Because waterway access is not available in all regions it is a unique element capable of influencing the decison to choose a specific region. At the intraregional level it offers a transportation alternative to industries that have already decided upon their region. In addition, it will be necessary to examine the importance of changing technology to both points of view.

At the interregional level Probst (1967) notes that technical and managerial progress has significantly reduced the importance of transportation cost to the location of industry. In a similar vein Friedman (1967) notes that "the national market is becoming increasingly accessible from all potential locations and external economies can be obtained on practically the same scale in all large metropolitan regions." He goes on to estimate that production costs probably vary by less than 10 percent among alternative locations and the difference may be declining (Friedman: 1964). Luttrell's (1962) studies in Britain indicated that about two-thirds of British industry could be considered "footloose". In other words the long run profitability would be about the same in all locations. Karaska (1969) adds further evidence to indicate that except in the case of heavy bulk and processing activities transportation costs are playing a declining role in the location decision. He also suggests that transportation may need to be examined from the point of view of flexibility, speed and availability of supply. Gray's (1971) findings suggest similar conclusions and it is stated: "as road facilities expand to coastal centers in the province, general commodity traffic is steadily shifting from from water transport to road transport." This phenomenon is occurring in spite of the savings available in using water transport.

A review of the transportation cost factor at the intraregional level points to similar conclusions. A major reason for increased mobility was the invention of the truck. Moses and Williamson (1967) note that it removed the dependence

on proximity to the railway terminal in its early stage of development, and reduced the overall importance of rail as it was improved. Pred (1964) notes that flexible movement afforded by improved roads and freeways now permits efficient local marketing from peripheral points. Barloon (1965) adds that low cost characteristics have been replaced by the greater importance of high speed service. He stresses the value of superior service standards, small lot movement, short door to door delivery time, and a high predictability of arrival time. Similarily Gray's (1971) study indicated a high preference for road transport.

The findings of a number of studies based on questionaire surveys also suggest a declining role for the transportation factor in both interregional and intraregional locations. The Employer's Council of British Columbia conducted a survey of secondary industry in 1969. It was concluded that market opportunities within the region and raw material availability were the most significant factors for both new and prospective industries. Transport facilities ranked fifth and sixth respectively. Evidence from Macmillan's (1965) survey article suggests that this finding is typical with the exception of transport facilities which usually rank slightly higher. A recent survey of plant managers in Vancouver by Richmond (1973) indicated that nearness to markets, skilled labour, and truck and rail transportation were important to all industrial categories. Nearness to markets was important for smaller firms, and the importance of truck transportation is stressed. Rail or water were important to resource processing industries,

and nearness to markets for the non-resource based. The minor importance of water transportation as a location factor is noted, and Richmond observes that this is indicative of the fact that only a small proportion of Vancouver's manufacturing industry is water oriented.

The role of technology in reducing the importance of water transport to the location of industry is increasing as new methods of cargo handling are introduced. Of particular importance is the move to containerization. Frankel (1968) estimates that 82 percent of the general cargo currently moved on the world's oceans could be handled by containers, and the berths required would be less than 60 compared to several thousand currently in use in U.S. ports. Labour terminal efficiencies are increased tenfold, and substantial economies of scale are introduced by the virtual independence of port time and unit container ship load. As a result there are major incentives to concentrate activity in a few ports and build a highly efficient road and rail feeder network. The consolidation and distribution functions give way to concentrated use of productive transport factors.

Containerization has several implications for industrial location. Firms which currently find it advantageous to have waterway access and ship directly may find it more economical to use containers loaded at a specialized port facility. Savings will accrue from being able to ship goods as produced rather than building the necessary stockpiles to fill a ship, and a wider range of ports will be available as containers can be

placed in small numbers on vessels bound for various destinations. There are several examples of firms which have found it advantageous to use container transport. The lumber industry for example, frequently finds it more advantageous to use containers rather than existing waterway access which may be enjoyed (Rimes: 1971). Although not fully containerized, the move to the packaging of lumber has lead to the building of an ultramodern lumber port and the phasing out of barging of lumber from mills to port areas for loading over the side (B.C. Research: 1967). Apedaile (1972) provides an increasingly typical example of an awkward cargo (newsprint) being taken by land to a sustantially more distant port in containers timed to coincide with shipping.

Thus there is considerable evidence to indicate a significant decline in the importance of waterway access for transportation as a factor of plant location. Changing attitudes demanding speed and flexibility have, with the possible exception of some resource based firms, lessened the desire to find the traditional Weberian least-cost location in both the interregional case and the intraregional case. The current trend to containerization suggests that for firms who must ship by water, greater savings can be had by using road or rail feeder lines to highly efficient port facilities than by locating on the waterfront and shipping directly. Thus, it is tentatively suggested that access to the waterway may not be the main determinant of the rental value of shorelands.

b. Related Location Factors

Past studies have identified a host of factors which are said to influence industrial location, but this section will be concerned only with those which, besides the waterway, may make shorelands attractive to prospective firms. Many factors are relatively uniform within a region, and these include wage rates, taxes, labour supply, transportation rates and utility rates. However, three factors may vary considerably: proximity to central business districts, parcel size, and foundations.

The first two of these factors have been extensively investigated by Goldberg (1969) and he notes that plants in less dense locations have greater internal returns to scale than similar plants at the city center (ie., they are larger and can internalize many of the services that a small plant would have to contract out), and because space constraints at a given site limit the amount of growth a plant can experience a plant must move to a less dense location if it is experiencing rapid growth. Goldberg's argument is supported by several other findings. Space for Industry noted that the ability of suburban areas to provide large parcels at relatively low cost is perhaps their key attraction to new industry. Chinitz (1964) noted that the greater availability of open sites is probably the most important single factor underlying the move to the suburbs. Vernon (1960) states that small firms are dependent on goods and services for production which they cannot provide themselves, and therefore have tended to choose more central downtown locations. When a firm grows it no longer requires the benefits of these external economies as they are able to internalize many

more of the functions needed for production. A related characteristic of firm growth is the ability to realize substantial economies of scale as a result of the technology of mass production.

This analysis has three main implications here. First, the shorelands on the North Arm are likely to exert an attractive force for many small and medium size plants because of the proximity to the central business area. A related consideration might be that a waterway using firm may exert an attractive force on related industry causing non-waterway using firms to locate on adjacent shorelands. Second, because most of the Fraser is in a non-central and low density location, it is possible that larger firms will be attracted to sites on its banks for that reason alone. And third, because large or expanding firms tend to seek sizeable parcels of land, and shoreland is currently subdivided into very large lots (they range mainly between 30 and 50 acres; G.V.R.D.: 1971), it may be difficult to distinguish between plants seeking waterway access and plants seeking larger sites. Therefore, it can be suggested that shoreland sites carry an important rental value for reasons other than waterway access, and because of this the importance attached to the waterway access component alone may be difficult to determine.

The importance of foundations is noted because much of the Lower Mainland is characterized by areas with very poor foundation conditions. Because the additional costs of fill and structures necessary to utilize these areas may be high, firms

will place a greater demand on lands with sounder footings. Foundations, therefore, may be an important component in the rental value of shorelands.

c. Firm Behavior

The preceding suggests that several factors may influence the rental value of shorelands. However, there is a growing body of literature which suggests that these factors are of only minor importance, and that patterns of industrial location display a high degree of randomness (Smith: 1966).

A number of empirical surveys have indicated that traditional economic factors are relatively unimportant in the choice of location. Hunker (1958) for example, found that "initiative and inventiveness have played an impelling role in the location of nearly 65% of Columbus' manufacturing establishments." Mueller (et.al.: 1961) found that personal reasons or chance determined the location of 50% of 296 plants surveyed. In his review of ten location surveys Turner (1971) also notes the overall importance of personal reasons.

Several conclusions which might be suggested in the preceding paragraph are strongly reinforced in Hodge's (1970) study of industries within a 100 mile radius of the Toronto region. He attempted to demonstrate the relationships between locational patterns and the variables, taxes, wages, transport costs, and land costs. He found a low correlation with taxes and wages, no correlation with land prices, and only some correlation with transportation costs. There was no correlation

with transport costs for the 7000 plants located within 50 miles of Toronto. "Thus the accumulated evidence of this study is that industry has not located at those location points in the metropolitan region which have the best configuration of least-cost factors" (Hodge: 1970).

Hodge attempts to explain his findings by examining two possible hypotheses. He suggests that either firms are irrational or least-cost factors are not significant enough to make a major impact. The importance of each factor is dependent on its share of the overall production cost. In the case of land he cites Ontario government figures that indicate that even in the highest cost location, land would represent no more than one-eighth of the total capital investment (assuming a one acre parcel, twelve workers, and $20,000 investment per worker). This is particularily interesting in light of the fact that land prices at the core are twenty times those at the periphery. He also found that firms up to 40 miles from the core could transport to market and distribution facilities at costs equivalent to those at the core. It is therefore concluded that firms are relatively indifferent to least cost factors, and it is suggested that amenity factors such as cultural and recreation facilities may be a determining factor.

The preceding observations have been used by researchers such as Townroe (1971) to argue that an alternative theory of firm location behavior is needed. His approach attempts to explain location in terms of behavior which is governed more by organizational considerations than pure economic logic. He

observes that individual firms approach locational problems from differing points of view. Some consider it a straightforward managerial task, and others consider it a major decision upon which substantial resources and expertise are brought to bear. In his research he found that most companies undertook a very limited evaluation of alternative locations, and that several companies were only looking for the minimum requirements site. Frequently decisions were made quickly and before a thorough analysis could be undertaken. In his survey 17/59 picked the first possible site, and 40/59 picked the first "satisfactory" site (satisfactory is defined as lying between minimal and optimal). It is interesting to note that locational decisions are unusual decisions for a firm to make, and behavior in this case may not reflect the firms normally strong least-cost goals. In addition it might be added that search costs, especially in terms of lost production time, may significantly outweigh any benefits to be dervied from an optimal location.

Thus there is a substantial body of theoretical and empirical evidence suggesting that location decisions are heavily dependent on personal preferences and company organization. It is doubtful that a uniquely optimal location exists or is in fact found, and firms are frequently willing to settle for the first feasible location. The ability to be satisfied by a sub-optimal site probably reduces the number of essential prerequisates for any given location. Thus the rental value attached to shorelands, or indeed any lands, may not be very high.

d. Summary

Three important observations can be drawn from this review. First, shorelands may be important to some types of firms, but the overall demand for them is not great. Second, factors of proximity, parcel size, and foundations may be important elements in the rental value of shorelands. Third, it appears that firms attach very little value to any particular location.

(2) Past Attempts to Measure Opportunity Cost

a. Quantitative Estimate of Rental Differences

Lind has been a major proponent of using differences among land rents to estimate the benefits from proposed flood plain protection works. His approach is based on the classical theory of rents where economic rent is defined as "surplus earned by a particular factor of production over and above the minimum earnings necessary to induce it to do its work" (Robinson: 1967). Lind defines the net benefits as the aggregate dollar values of the economic gain of firms or households that find it profitable to move into a flood plain once protection has been established. The opportunity cost of not providing protection is the value of those benefits not realized.

The measurement of the aggregate value of the rental changes involves two main steps. Rephrasing his description in terms of the shoreland situation, it would first be necessary to predict which activities would move onto shorelands given industrial zoning and municipal servicing. Then for each of the activities it would be necessary to know the new set of rents that would be realized. This would involve an accounting of the

costs and savings of waterway transportation, and of changed foundation conditions, proximity to business districts, ground transportation services, utilities available, and any other factors related to specific industries. By summing these differences, Lind argues, one can estimate the benefits of industrial use of shorelands.

This is clearly a tall order and one may rightly question its feasibility. Although Arvanitidis (1972) has applied it with some success to residential land uses, no other applications were found. (Lind only developed the theoretical constructs.)

In addition to these measurement problems, a number of conceptual difficulties were noted in considering the use of Lind's approach in the study area. Lind cautions that it is only applicable to relatively small projects. The main reasons for this are that large projects may influence prices for goods and services produced on land, and that the location pattern will not be known in advance where development of a large region is concerned. The importance of the first qualification in the Fraser is uncertain, but the second factor is likely to be a limiting element. As Koopmans and Beckman (1957) caution, it would be "quite inadequate" to assume that the use of one location does not depend on the use of another location.

A number of other more general issues relating to the applicability of rental value can be introduced which limit the direct use of this approach in the shorezone. Two basic assumptions of the theoretical model are perfect knowledge and

pure economic motivation. In other words if a flood plain is dyked or a new transportation facility built and the land parcels affected take on a higher rental value, and this change in value is used as a measure of benefits, industries will have to be aware of the difference and willing to move if this measure is to be accurate, (Lind has also assumed away the cost of moving). If the cost savings to be realized from waterfront locations are to be considered as opportunity costs of not allowing shoreland occupancy then they must be perceived and taken advantage of if they are to be meaningful. But, a look at the literature on industrial location suggests that firms are neither well informed nor rational (eg., Hodge: 1970, Townroe: 1971). Because they do not consistently respond to the availability of more valuable locations this measure would reflect potential rather than real benefits. If an alternative argument is posed, that firms are both informed and rational in that it is not worth it for them to move, the benefit estimate would be insignificant.

A second important issue concerns the assumption of perfect mobility. Turvey (1957) notes that "if conditions were different and buildings had very short lives, the actual shape and form of a town would be close to its equilibrium pattern." Because capital improvements are placed on the land, and the value of the land resource takes on these as well as the land itself, the rental value of the land alone may not be the only consideration. "Therefore, shifts to uses that place structures on the land become virtually irreversible even when the supply and demand conditions that created the original shift have

altered" (California: 1971).

b. Quantitative Estimate Based on Land Prices

In his article on nonstructural measures for flood damage control James (1965) has developed a model based on land value data which are capable of estimating the opportunity cost of not developing a flood plain. He argues that the "market value of land is presumably the present worth of its future time stream of expected net income or rent." It reflects such advantages as accessibility, fertility and foundation conditions. The main reason cited for using land values is primarily ease of measurement.

To attempt to gauge opportunity cost otherwise, he argues, would involve a very complex and detailed analysis. Agricultural productivity and foundation conditions could be estimated from comparisons with nearby areas and the advantages of location and accessibility would have to be evaluated on the basis of possible alternative sites for development. Whether this would occur within or outside of the region would be of importance, and a major problem would be to develop a means for evaluating the impact of preventing development in one area on the locational decisions throughout the region.

The essence of James' method is the subtraction of the present value of the market price of a parcel of land in the future from the current market price multiplied by a factor reflecting the productivity of the site for a given use. This produces a value which estimates the net urban or developed

income. The annual location cost of preventing urban development during a specified period can be determined by subtracting out the possible net agricultural income and the possible net public income if urban use is totally excluded.

Without describing the method in further detail, the most important point of contention is James' use of land values for the measurement of opportunity cost. The importance placed on the rate of return on a given land investment would tend to imply that urban users, and particularily industry in this case, located primarily on the basis of land prices. This notion would seem to be highly questionable as the price of land to several urban uses, such as highly automated manufacturing, represents a very low proportion of overall investment at a site.

An examination of the industrial location literature indicates that the price of land is not a major consideration. Studies in Toronto by Kerr (1968) and Hodge (1970) indicated that land costs did not make a difference to plant location. Hodge's study strongly suggests an apparent indifference to pure economic factors. Transportation costs and tax rates were also included in the analysis. Steed's (1972) analysis of the locational dynamics of manufacturing in Vancouver observed an interesting anomaly that concurs with these findings. An unusually large number of small plants were found in the outlying areas, while a great number of large plants were found near the central city area. The general pattern in other cities is exactly opposite as small firms are usually willing to pay

high central area land costs in return for access to the services of other industries. Measurements of the rate of return per land parcel type, therefore, are liable to yield highly unreliable results.

A more mechanical problem with using James' approach arises from the choice of land value data. Municipal tax assessment roles, real estate company appraisals, and actual sales prices are liable to be quite different. Local variations have also been noted by Solzman (1966) who found that non-waterway using plants usually paid less for a similar parcel than those highly dependent on access to the waterway; the vender having adjusted the price accordingly. Therefore, the use of land values to compute the rental value or opportunity cost will not produce a consistent quantitative estimate.

c. Quantitative Estimate of Relocation Cost

A California (1971) coastal zone study undertook a direct measurement of the opportunity cost of not allocating shorezone space to industry by asking individual firms what additional costs would be incurred if they were forced to seek an inland site. The measurement of opportunity cost involved an interview-questionnaire; twelve representative use categories were surveyed. The questionnaire measured both extra investment and extra operating costs, but with numerous qualifications and assumptions. Among the study's conclusions it was noted, for example, that a small plant on the shoreline may have to be considerably larger if it were to locate inland, and investment would have to more than compensate for the loss of

waterfrontage. The opportunity costs also fluctuated according to variations in physical geography and proximity to other developed areas.

Local supply and demand conditions and technological idiosyncracies made it difficult to classify meaningfully shoreland users according to dependency. The report stresses that all measurements are specific to the firms consulted and they have limited utility outside of that context. Because of the problems raised by this study any direct measurement of opportunity cost in the same terms would have to be undertaken with considerable care and well qualified in each case. However, it is not likely that such measurements would need to be made in the study area as its essentially vacant nature has placed the emphasis on future needs rather than relocations. The only instance where they are unavoidable is in the forest industry's use of foreshore and water lots for the storage of logs, but the problems associated with the calculation of the costs of alternative methods of log storage are much less complex.

B. ANALYTIC FRAMEWORK FOR THIS STUDY

It would appear that Lind's study provides the best means of evaluating social opportunity cost at the current state of the art. It involves an estimate of the rental differences between shoreland and upland sites. The procedure begins by forecasting land uses, and goes on to examine the costs and

savings of several factors which affect productive activities, such as foundations, waterway access, proximity, and related services. Despite the measurement and conceptual difficulties mentioned, this approach would likely produce a reasonable estimate for a small flood plain or shoreland development project.

However, a number of reasons can be cited why the rental difference approach is unsuitable for this study, at least at this stage in the study area's development. Formost of the reasons is that Lind's work was concerned only with immediate use. When he refers to forecasting land use he is only concerned with activities which will move onto a floodplain as soon as protection works are built. In this study the concern is with distant returns from a much less predictable demand for waterway access over a long period of time. When the shorelands have filled in with more development and the nature of the demand is more pronounced, application may be warranted. In so doing, however, it could only be applied to a small part of the study area where locational patterns were well determined in order to avoid the problems associated with locational interdependence. Another issue which was raised in the literature review was that rental value differences may not be high enough to produce significant estimates.

These observations suggest that the best course of action which can be undertaken at the present time is a qualitative evaluation of social opportunity costs. This is based on a review of the demand and supply for Fraser shorelands. Three

main considerations are suggested by the identification of conflicts in Chapter Four. First, it will be necessary to examine the demand and supply for waterway access because the preservation of recreation sites would be at the expense of 9.6 miles, or 16%, of the region's vacant industrial waterfrontage. Because this is most important, demand and supply will be considered separately in two sections: the first will examine the rental value attached to waterway access, and the second will compare the supply of waterway access with projected demand for it. Second it will be necessary to consider the supply and demand for industrial land in the region because the preservation of recreation sites would involve the forgoing of about 500 acres, or 5%, of the region's supply of vacant industrial land. Third, the cost of alternative log storage arrangements will be evaluated in pecuniary terms to determine the cost of removing 8% of the log storage area in front of major recreation sites. The remainder of this section will review the procedure for each phase of the analysis. It will be divided into two sections: the first and most important concerns limiting shoreland use for new plant sites and the second concerns log storage removal at major recreation sites.

(1) Limiting Shoreland Use for New Plant Sites

a. Demand for Waterway Access

This section will examine a number of indicators of shoreland demand in order to determine the rental value attached to shoreland. This will not be calculated in pecuniary terms for the determination of opportunity cost; it will be based on a

qualitative assessment of current shoreland use, recent trends, firm needs, relative land costs, and specific changes in industrial shoreland demands.

Current Use. A good understanding of the value placed on shoreland can be derived from an analysis of patterns of occupation and use. The first step will be the enumeration of existing industrial users according to two digit classes used in the Standard Industrial Classification Manual (Canada: 1970). Any use an industry makes of the River, for transportation, water supply, or waste discharge, will then be listed from field observation, Pollution Control Board permits and past studies. This will produce tables showing types of industry and main use, which can be interpreted to describe the general need for shoreland by type.

Recent Trends. The second step will introduce the time of location to the list of shoreland plants in order to plot new industrial locations by type for each year since 1960. This will indicate the trends in type of industry locating over a twelve year period which will identify those industries which are not growing. By introducing the type of use information it will be possible to determine whether new plants are actually using the waterway, and for what purpose.

Firm Preferences. While some local industrial location studies will be used, a survey was undertaken in order to identify any regional deviance from the general patterns which are suggested by the literature. It was found that many surveys of plant managers were likely to be unreliable, and in

consultation with a specialist in plant location, Dr. Mike Goldberg, it was decided to undertake a survey of industrial realtors. Because realtors constantly work with industry they are more likely to be aware of the needs and preferences of firms than individual plant managers who may not even have been involved. The questionnaire was designed to determine the overall importance of shoreland to specific industrial types, and it identified those for which it is absolutely essential.

Specific Industries. In the review of studies of industrial land needs it was observed that many of the forecasting problems which were encountered were based on the reliance on past trends. Therefore, it was decided to examine those firms which are common waterway users but which may have changing needs in the future. The importance of containerization to the shoreland needs of port industry, and the growth rate of the forest industry, currently the major land user, were examined.

Land Cost. Market value information can be utilized to provide an indication of the relative demand for land in certain locations. Although different sources of land value data may vary, the relative importance of various parcels of land is likely to remain fairly constant, and it is safe to rely on one source providing that it is only used for comparative purposes and no attempt is made to calculate an actual rental value. In this case data was available from real estate appraisers.

The analysis will illustrate the relative importance of the waterway and proximity to downtown as determinants of land

prices; therefore, providing a qualitative indication of the value placed on shorelands. The methodology for doing this will be borrowed from an excellent study by Solzman (1966) who used property value information to plot changes in value along the Chicago Ship Canal to determine whether shoreland was more valuable because it was shoreland or because of its proximity to the city center. Similar data are available for much of the study area and it can be used in a similar manner along the length of the Main Arm, as well as to compare riverfront property values with other industrial land values. (Although the Chicago Ship Canal and the Fraser are not strictly comparable because the Fraser does not intersect the central Vancouver business district, it is fronted by a significant regional center). Some data is available for various years so it will be possible to suggest whether demand is increasing or decreasing.

b. Supply and Demand for Waterway Sites

This section will be concerned with the supply and demand for waterway sites in terms miles of usable waterfrontage. Following a review of past studies of industrial waterfront needs in the study area, the discussion will examine the capacity of shorelands and project possible rates of occupation.

Past Studies. Because other studies, particularily Space for Industry (G.V.R.D.: 1971) and Dynamics of Industrial Land Settlement (L.M.R.P.B.: 1961), have made a number of observations and predictions concerning the Fraser, these will be introduced at this point for a general comparison.

Capacity of Shorelands. First, it will be necessary to exaimine the capacity of shoreland sites to accomcdate new industrial expansion. This will be done by comparing existing mileage used with potential mileage available. A possible doubling or tripling of shoreland occupation will be pcstulated to determine the capacity of vacant land to absorb expansion without utilizing any of the major recreation sites.

Rate of Occupation. The second step will be to examine the current rate of industrial expansion on shorelands. Using the information generated in the anlysis of use and trends, a number of alternative rates of growth are postulated. These will be used to suggest when shorelands are likely to becme fully occupied for different types of use.

c. Demand and Supply of Industrial Land

The possible removal of 5% of the region's total supply of land designated industrial may have an impact on the land market. An examination of the importance of the Fraser shorelands as a part of the region's total supply of industrial land will be made primarily from a review of Space for Industry. It provides a detailed inventory of the region's supply of land, and makes a series of projections of possible future industrial land needs.

d. Qualitative Evaluation of Social Opportunity Cost

This section will summarize the findings of each of these sections in order to provide a qualitative evaluation of the

social opportunity cost of preserving recreation sites.

(2) Log Storage Alternatives

Conflict with the forest industry's use of foreshore and water lots for log storage was identified as the most immediate problem facing recreational use of the sites identified. In order to alleviate the conflict other storage alternatives were considered which would not require the use of these sites. The additional costs were determined for each of three alternatives: relocation, seasonal use at recreation sites, and bundle booming.

Chapter Six

The Social Opportunity Cost of Preserving Recreation Sites: An Analysis of the Demand and Supply of Industrial Shoreland

Chapter Five concluded with a detailed outline of the approach adopted for examining the social opportunity cost of preserving the major recreation sites identified in Chapter Three. Based on the two main types of conflict identified in Chapter Four, the analysis was divided into two parts. The first and most important of these concerns the social opportunity cost of restricting the number of new plants which might be allowed to locate on shoreland. The second part is concerned with an evaluation of the cost of log storage alternatives which might be used to free major recreation sites.

This chapter will deal with the first phase of the analysis. The examination of the possible implications of limiting new plant locations will be in three parts. First, empirical evidence will be reviewed to determine the importance of waterway access as a factor in the rental value of shoreland. The examination is designed to evaluate qualitatively the rental difference between shoreland and upland industrial sites. Second, the analysis will quantivatively examine the supply of

shoreland sites (in terms of length of shoreline), and project some possible rates of occupation according to alternative levels of demand. Third, the preservation of shorelands for recreation will be examined in terms of a possible reduction in the region's supply of industrial land.

A. RENTAL VALUE OF WATERWAY ACCESS

Several factors were identified earlier as contributing to the rental value of land (eg. foundations and services), but this section will only be concerned with that value which is added by access to the waterway for transportation. Four reasons why firms choose waterfront locations can be cited:

(a) large quantities of water are required for industrial purposes,

(b) waterfront locations are advantageous for the disposal of industrial wastes,

(c) manufacture or processing of water related products (eg., fishing camps, shipbuilding),

(d) either the raw material or finished product is transported by water.

There are a number of reasons why only the latter two categories are considered to be important in this study. Information concerning the use of River water for industrial purposes is difficult to obtain, but according to Goldie (1967) it is limited. Water use is mainly confined to heavy duty cleaning operations and can best be described as an extra

benefit of shoreland location rather than as a determinant. This picture is not likely to change in the forseeable future as River water is too silty for most purposes, and no supply problems from existing North Shore sources are envisioned by the Greater Vancouver Sewage and Drainage District (Rees: 1972).

In order to determine the importance of the waterway as an outlet for industrial wastes, lists of Pollution Control Board permits were consulted. Information from this source was inconclusive, however, as examples of almost every type of firm had outlets. The only category identified with consistently high volumes of discharge was the food industry, and it is conceivable that a ready source of waste disposal (the Fraser) was a location determiant. While this may be correct, the rental value of riverside waste disposal was not considered for two reasons. First, it is likely that this factor has been more important in the past than it will be in the future as recent pollution control regulations make it difficult for firms to dump huge amounts of untreated wastes directly into the River. Second, the cost of extending discharge pipes a few hundred feet to provide access to the shoreline was found to be a relatively minor component in the total investment made by new shoreland plants (California: 1971).

(1) Industrial Use of Fraser Shorelands

The purpose of this section will be to identify the kinds of industries occupying shoreland, the nature and extent of their use, and the main reaches of the River where shoreland has been developed.

Table Five, which is based largely on an extensive field survey in the summer of 1973, illustrates the importance of each of eleven categories of observed use. The first nine of these represent the titles of two digit Standard Industrial Classification Manual categories, and the last two are catchall groups which include a number of diverse uses. Wood industries are clearly the most important industrial activity on the River, and they account for 27% of the occupied shorelands. Non-metallic mineral industries occupy 11%, water transport 6%, and metal fabricating 4%; other industrial uses vary between 1 and 3%. Mixed uses account for as much of the shoreline as the wood industries, but these can be described as considerably less intensive uses in that much of the shoreland classified under this heading is made up of small fishing floats, old sheds, and houses with associated fishing activities. It would probably be reasonable to consider much of this shoreland vacant from the point of view of industrial expansion as the value of the structures themselves is typically low.

Table Five

Industrial Use of Fraser Shoreland

(Fieldwork: 1973)

CATEGORY OF USE	NORTH ARM MILES (%N.ARM)	MAIN ARM MILES (%M.ARM)	TOTAL MILES (TOTAL)
food and beverage industry	0.4 (2)	0.6 (3)	1.0 (3)
wood industries (including furniture indust.)	6.3 (37)	4.4 (19)	10.7 (27)
paper industries	0.3 (2)	0.3 (1)	0.6 (1)
metal fabricating	0.9 (5)	0.4 (2)	1.3 (4)
transportation equipment (shipbuilding)	0.4 (2)	0.5 (2)	0.9 (2)
non-metallic mineral industry (including gravel storage)	1.7 (10)	2.7 (12)	4.4 (11)
chemical industries	0.4 (2)	0.4 (2)	0.8 (2)
water transport	0	2.5 (11)	2.5 (6)
storage and warehousing	0.6 (4)	0.5 (2)	1.1 (3)
mixed uses[1] (fishing camps, boat works, dredging,etc.)	3.0 (17)	8.0 (35)	11.0 (27)
other[1] (institutional, recreational, etc.)	3.2 (19)	2.5 (11)	5.7 (14)
TOTAL	17.2 (100)	22.8 (100)	40.0 (100)

1. evaluation was particularily difficult in these categories and they can only be considered as reasonable approximations to show orders of magnitude

The two types of River use which will be considered as prime generators of rental value are the processing of water related products and transportation. In the case of the former it is essential that major shipyards, fishing camps and shipping terminals have shoreland for waterway access. The shoreline

length occupied by these categories is displayed in Table Five. In the case of shipbuilding and water transport 100% of the firms occupying shoreland use the waterway. However, because "mixed uses" refers to almost any difficult to classify shoreland structure, all of the length cannot be considered as used.

Of the four uses listed, the use of the waterway for transportation by industrial firms is the most important consideration in assessing the rental value attached to shoreland. Because this is clearly the largest use a detailed examination of its current importance was made. For each of the shoreland industrial categories identified an approximate estimate of the proportion of shoreland occupiers actually using the waterway for this purpose was made. Based on the firms identfied in a field survey the following list shows the percentage of firms in each category which use the waterway for transportation purposes:

wood industries -- 90% or greater

non-metallic mineral industries -- 90% or greater

paper industries -- 30-50%

metal fabricating -- 30-50%

storage -- 30-50%

chemical industries -- 20% or less

food and beverage industries -- 20% or less

The percentages shown are listed in round figures because it was sometimes difficult to determine if firms actively use the waterway or if they used it at one time but no longer do so. Also an accounting based on only two possible categories, user

and non-user, may be misleading in that intensity of use can vary from a once-monthly shipment at an imported car unloading dock, to several barge loads of gravel in one day at a concrete manufacturing establishment. Similarily the intensity of shoreline use varies as firms may only require one-quarter of the actual front footage they occupy for dock space.

Table Five also illustrates a marked trend toward specific locations. Although the North Arm only has one-half as much shoreland designated industrial as the Main Arm it accounts for 43% of the total occupied length, and 48% of the length taken up by the nine specific industrial categories. The forest industry and the non-metallic minerals are noticably more concentrated in the North Arm. Because the North Arm is considerably closer to the central business district than other parts of the River it is possible this may have been an important factor in the distribution (it is about one-half of the commuting time away compared to other areas, L.M.R.P.B.: 1961). This observation is supported by Figure One which shows the north bank to be more intensively used than the south bank of the North Arm.

The tendency to favour the North Arm indicates a greater importance of shallow water rather than deep water oriented use. A large number of firms on the Main Arm also use only shallow draft frontage, and a number of firms occupying deep draft sites utilize them only for barge or booming activities which require only shallow draft capability. In the wood industries one mill uses its site's deep draft potential, but even this has declined as lumber from this mill is now trucked to a central shipping

terminal in Burrard Inlet. Thus use of the River on all reaches is more oriented towards coastal movements of heavy or bulk products than to deepsea shipping.

Aside from actual port industry, the only deepsea use is by one food processor, one metal fabricator, one non-metallic mineral products firm, and two storage and wholesale firms. This is clearly a small proportion of well over 200 shoreland occupying firms in the study area.

Further investigation of the distribution of shoreland occupiers revealed that 28% of all shoreland use in industrial designated areas was on land considered to have poor or very poor foundation conditions. As most of this is in the vicinity of major transportation routes to the central business district on the North Arm, and near the Patullo Bridge on the Main Arm it appears likely that these are the major influences on indusrial location.

A final spatial consideration concerns the distribution of waterway transportation users. In this a definte pattern emerged as few examples of non-users were noted on the Main Arm, but on the North Arm several were found. Major examples included metal fabricators, a paper box company, chemical plants, boat builders, food processors, and furniture makers. This observation would suggest that factors other than waterway access have been important determinants of shoreland site use; and proximity to downtown may again be the vital consideration.

(2) Recent Trends in Shoreland Plant Locations

In order to establish a picture of the trends in Fraser shoreland industrial occupation and use, Dominion Bureau of Statistics lists of new industrial plants established in the G.V.R.D. were consulted for a twelve year period between 1960 and 1972. Each industry was classified into two digit S.I.C. Categories and the shoreland occupiers determined from the addresses provided. They were classified as users and non-users from fieldnotes used in the previous section. As a cross-reference similar lists prepared by the Provincial Department of Trade and Commerce were also consulted, and to ensure that no shoreland using firms were missed annual lists of foreshore leaseholders were also examined. Although the completeness of this list can never be ascertained there is no reason to suspect that it favours or ignores any one sector, and it is likely that all of the major plants are included because original data sources included building permits and trade journals. However, because the data does not show firms going out of business, or those taking over an existing operation, there may be more new starts shown than the number of currently operating firms. In order to include a rough estimate of size, data on acreages occupied by each firm were provided by Mr. E. Levesque from his survey of industrial plant locations.

The main results of the investigation are summarized in Table Six. A total of 1194 new plants located within the G.V.R.D. during the twelve year period, and of that 43 chose Fraser shoreland locations. However, a more revealing picture can be had if we consider only the firms which occupied one acre

or more, and the total in this case was 339, and of that 37 were on the shorelands. With the exception of four small wood industries (less than one acre) most of the firms were of the greater than one acre in size. Examining each group individually it can be seen that only 4 of 32 food and beverage industries located on the shorelands. Looking at the wood industries it must be noted that more than sawmills are included in the category, and that all 10 of the new mills located on the shoreland. Only 2 of the 63 other industries in this group chose shoreland sites (eg., furniture industries). Of the mills it was also noted that only two of them occupied more that five acres. Very little growth was experienced in the paper industries and the one new shoreland occupier was a non-user of the waterway.

The opportunity to utilize the waterway was taken by only 3 of 44 new metal fabricators, while two chose a shoreland site without using its waterway access advantage. Four new boatbuilders were noted, and all of these occupied small sites with only shallow draft capability. Fraser shorelands were clearly attractive to non-metallic mineral industries as nearly one-half of these located there, and all of them were waterway users. One new waterway using chemical industry was located from a total of 17 new ones, but it was notably the largest in the group. No new shipping terminals on the Fraser were reported in the lists but three others were found elsewhere in the region. Major bulk terminals were located in North Vancouver and Roberts Bank, and a major cargo terminal was also located in North Vancouver.

Examining the areas which have attracted the largest number of new firms, the North Arm has clearly been the most active. However, it has also attracted the greatest number of non-users suggesting that other factors were more important than the waterway. Again nearness to downtown can be suggested. The attractiveness of the North Arm also implies that shallow draft waterways are favoured; and on the Main Arm only 6 of the 16 waterway using firms, 13 of which had at least port oriented industry capability, utilized their sites for more than shallow draft uses. It was observed that industries locating along the Main Arm were generally much larger than North Arm firms, as 9 plants occupied 6 acres or more, compared to only 3 plants in this group on the North Arm.

Table Six

New Industrial Establishments

(D.B.S. and B.C.: 1960-1972)

	NORTH ARM	MAIN ARM	TOTAL RIVER	TOTAL GVRD	GVRD >1AC.
	new plants >1acre (non-waterway)			users)	
food industries	2 (2)	2	4 (2)	101	31
wood industries	7 (2)	3	10 (2)	190	73
paper industries	0	1 (1)	1 (1)	22	6
metal fabricating	4 (2)	1	5 (2)	197	44
trans. eq. (boatbuilding)	2	0	2	6	4
non-metallic minerals	5	4	9	51	22
chemical industries	1 (1)	1	2 (1)	72	17
water transport	0	0	0	3	3
storage and warehousing	0	2	2	43	15
all other	2 (1)	0	2 (1)	508	122
TOTAL	23 (7)	14 (1)	37 (9)	1194	337

In addition to the information generated from an analysis of new plants, an attempt was made to determine the attraction of shorelands for new investment in established plants. The lists of new industries compiled by the Province also show the value of new investment, but the data were not complete enough to use for a quantitative analysis. However, it can be observed that forest industries, metal fabricators, and non-metallic mineral industries on the Fraser shorelands were the most active, but there is no evidence to suggest they were more active than inland firms. One noticable exception, however, was

with shipping terminals and considerable amounts of capital were spent to update and expand existing facilities.

Thus it can be seen that Fraser shorelands have not been a major attractive force for prospective new firms in the G.V.R.D. and less than 10% of the new plants over one acre in size were waterway users. The Fraser has clearly been most important to new sawmills and non-metallic mineral industries, and only occasionally important to other industries. Shallow draft capability and the North Arm are also noticably favoured among new plant sitings. The number of non-using firms along the North Arm would tend to suggest that competition for waterway sites is not related so much to waterway access as to other factors.

(3) Firm Needs and Preferences

The process of shoreland allocation would be made considerably more simple if it was possible to know which firms must have waterway access for transportation purposes, and which firms could easily do without. While this study cannot claim to have the answer it is felt that a reasonable indication can be gotten from a survey of industrial realtors. Because they have an intimate knowledge of industrial needs, and because they will tend to be less biased than plant managers who will be looking at their decision in retrospect (if in fact they were even involved), they were chosen for the survey. A total of nine completed questionnaires. They were chosen in consultation with the Secretary of the Greater Vancouver Real Estate Board, and every effort was made to select the most knowledgable.

It must be noted, however, that caution is needed in the interpretation of questionaire results. "Inherent inconsistencies, biases and mere inaccuracies, in combination with an appealing elegance and simplicity pose obvious dangers for use by regional economic policy and planning authorities" (Nishioka and Krumme: 1973). Frequently results are presented in a highly aggregated fashion which makes sweeping generalizations about all types of industries. Often the questionaires list a number of factors to be ranked, and in so doing automatically limit the respondents perception of the decision problem. For these reasons results of surveys must be carefully interpreted. In order to try to to avoid some of these pitfalls an open ended questionaire was used (see Appendix III), and it simply asked the realtors to list the ten most important factors for the location of each category. They were then asked to place an E beside those which were considered essential. The categories used were those identified in the various sections of this chapter as being prospective shoreland users.

The results are summarized in Table Seven, and the ranked importance of waterfrontage is shown for each. It can be seen that in no case did the food and beverage industry or storage and warehousing need shoreland according to the realtors. In the wood industries the realtors were informed that sawmilling was the main interest and the results reflect the need for waterway log handling. The most interesting results were the non-metallic minerals and the metal fabricators which show up as

only occasionally requiring shoreland according to the realtors. This would seem to contradict the current trends in these sectors to some extent. In the other industrial groups it is fair to interpret the realtors as saying that waterway access would be preferable by some but clearly not essential.

Table Seven

Results of Survey of Industrial Realtors

INDUSTRY TYPE	RESPONSE OF EACH REALTOR								
food industries	0	0	0	0	0	0	0	0	0
wood industries	E	E	E	E	E	E	E	E	E
paper industries	E	6	2	3	4	3	2	E	3
metal fabricators	4	0	0	3	4	3	0	0	2
chemical ind.	E	0	0	3	3	2	3	2	3
petroleum refin.	E	3	2	3	2	2	3	2	E
non-metallic min.	E	4	0	3	3	0	E	0	2
storage	0	0	0	0	0	0	0	0	0

E - waterway access is essential
0-10 - order of importance shown in questionnaire

Discussions with individual realtors indicated that plant managers were seldom well informed of the locations available to them, or even of their own site needs. The level of knowledge is frequently so low that a realtor must tell his client what his needs are. The importance of the order in which plant sites are visited and personality of the realtor were mentioned as being important. Generally the firms are willing to settle for an acceptable rate of return rather than seek the least-cost

location.

The results of this survey would appear to indicate that shoreland is essential mainly to the sawmilling industry, and that a number of others prefer it. But on the whole the opportunity for waterway transportation afforded by shoreland sites was not essential. It was also noted that firms are not well aware of their location needs and frequently choose their sites after very little deliberation.

(4) Specific Industries

At the outset it was thought that an examination of the possible growth of all industries requiring shorelands would be an important element in the analysis of demand. However, the examination of potential conflict in Chapter Four, and the analysis of existing use and recent trends indicated that two specific categories -- wood industries and port industries -- were of much greater importance than all others. The recreation sites were found to strongly conflict with land suitable for port industry, and the wood industries were noted as the main shoreland user. The results of an examination of their needs has significant implications for the Fraser which may outweigh any observations in the remaining categories.

The implications of containerization on port industrial needs for shoreland are sizeable in that much of Vancouver's general cargo could be moved through one or two modern terminals which would occupy considerably less shoreline footage than existing types of docks. Although much land may be required for

loading and storage facilities directly behind the actual dock, the high speed with which ships are loaded and unloaded greatly decreases the time spent in port, and thus reduces the number of docks required to move a certain amount of cargo. Frankel (1968), in his landmark article, cites evidence which demonstrates that the switch to containerization increases ship productivity by a factor of about 3, while the productivity of dock, labour and terminal resources increases by a factor of 10. The trend to containerization of world shipping has now become a reality and the ports in the Vancouver area have already begun to convert (eg. Centennial Pier).

While containerization is likely to reduce the need for shoreland in the future, other information was found which indicated that general cargo was not likely to be the main component of all cargo shipped in the future. According to B.C. Research Council (1967) findings, the total volume of general cargo moved through the port of Vancouver in 1966 was 2.72 million shipping tons, while a similar total for bulk cargo was 9.85 million shipping tons. And according to their projections, the figure for general cargo is only expected to increase to 7.6 million shipping tons by 1985, while for bulk cargo it is expected to be 38.2 million shipping tons. On this basis, therefore, it is likely that the need for bulk terminals will be of greater importance in the future.

It was observed previously that the region's two new bulk terminals did not choose Fraser sites. And furthermore it is highly unlikely that the River will be very attractive to this

activity in the future because of the 40 foot draft limitation. Current world shipping trends are toward bulk carriers drawing 60 to 70 feet. According to Ross (1970), an acknowledged expert in port design, bulk terminal developments should only be considered for harbours having present day depths to 72 feet and the ability to go deeper in the future as required.

The possible growth of the forest industry was also examined in some detail as it was found to be the major shoreland user. In this case industry executives and harbour authority officials were firmly in agreement that no new plants would be established in the study area in the future. Because the allowable annual cut in the coastal region is currently being harvested the only expansion likely in the Fraser will be from relocations from False Creek or Burrard Inlet. It was also observed that at least four mills have closed in recent years, and the number of mills in the province as a whole has decreased while the production has increased (B.C.: 1972).

(5) Valuation of Shoreland

In Chapter Three it was suggested that market prices can be used to yield an approximate indication of the value placed on shoreland by industrial operations (in areas which are zoned industrial). Data were obtained from interviews with the land assessor who undertook a study of shoreland values for the Fraser River Harbour Commission to use for the establishment of rates for their foreshore and water lot leases (Keenlyside: 1973), and from the Greater Vancouver Real Estate Board's annual survey of industrial land values. It was analyzed in two ways:

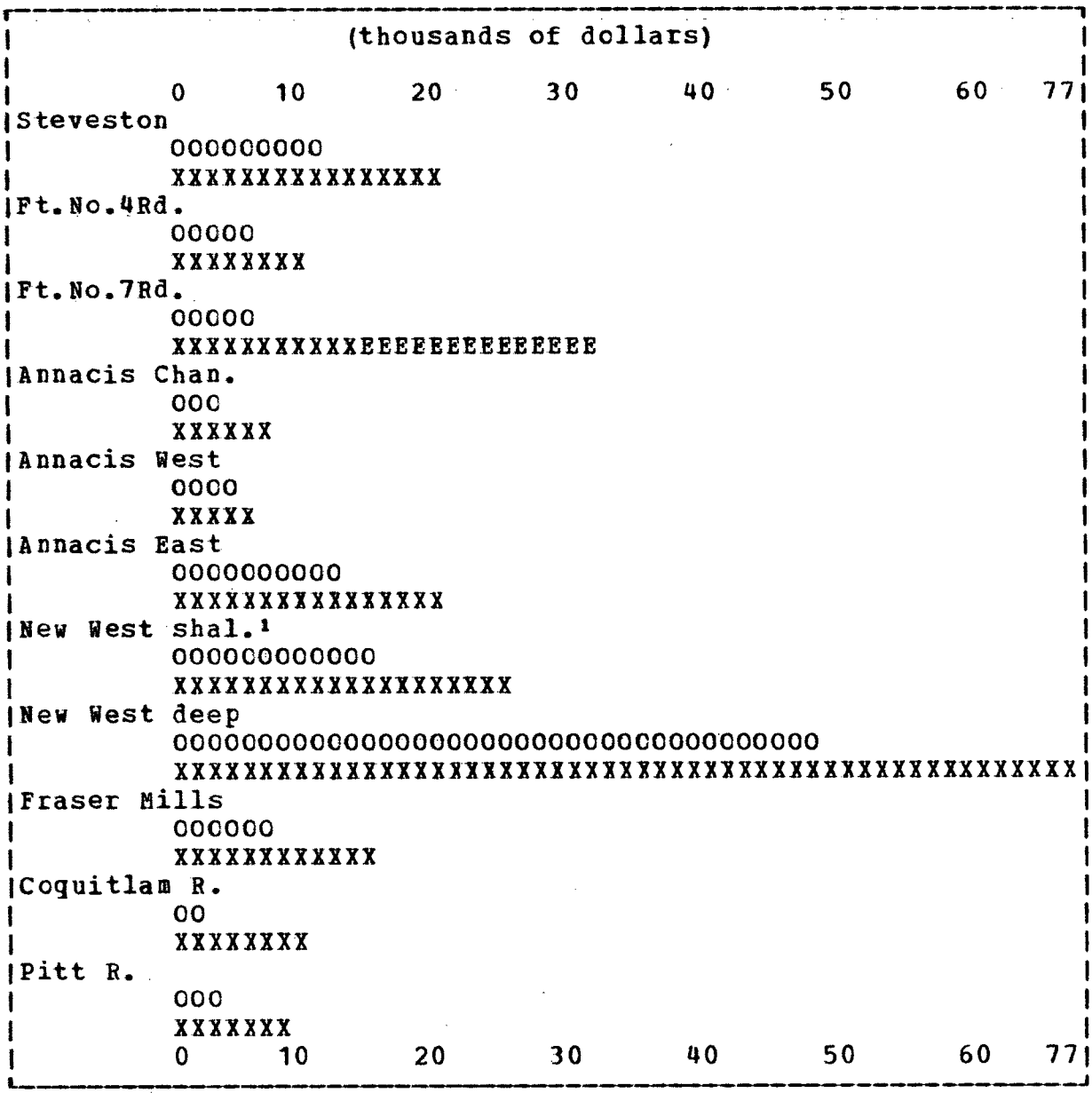
first, a profile of land values was constructed along the Main Arm, and second, industrial shoreland values were compared with other industrial areas in the region.

Table Eight was constructed to show the differing land values along the north bank of the Main Arm. Values on the south bank were generally more uniform and lower, and not shown. Similar data were not available for the North Arm. The table shows that shorelands in the vicinity of New Westminster carry a much higher premium than other parts of the channel. Shallow water frontage areas near New Westminster are also more expensive than all other areas along the River, most of which had port or port oriented industry capability. Annacis Island property, the value of which is derived from long term lease rates, was notably above average, as was Steveston property. This illustrates a close relationship between proximity to the services of an established industrial area and higher land values. The New Westminster area is also closer to the downtown Vancouver area than most other locations so it may be attractive for this reason as well as in its own right as an industrial area. Areas within a similar commuting time to downtown (as shown in L.M.R.P.B.: 1961) on the southern shore of Lulu Island did not carry high values, however, suggesting that they are either not perceived as being close, or that firms fear the traffic bottlenecks which develop on the freeway and the Oak Street Bridge.

Table Eight

Land Values Along the North Bank of the Main Arm

(Keenlyside: 1973)



O - 1969
X - 1973
E - estimated cost of fill
1. this area is at the entrance to the North Arm

Generally speaking areas with poor foundation conditions were of low value compared to other areas but the difference was not great. In order to obtain a more accurate picture of land values on poor foundations information was obtained on the cost of filling in areas of this type for industrial use. Using the foot of Number Seven Road as an example, the site has a peat layer up to 23 feet thick resting on silty clay (B.C. Hydro: 1963). A similar area, but with a thicker peat layer was found to cost about $17,500 per acre to compact and raise with sand, gravel and hog fuel (Swan-Wooster: 1972). When added to the land value this raised the total market price of the land in a usable form to about $31,000. This is still considerably lower than the more central New Westminster location. Some of the values may be slightly lower because the parcels tend to be larger than average, therefore, commanding a lower per acre price.

Table Nine shows a representative list of industrial land values in the Greater Vancouver Area. Although no data could be found for the North Arm the figure shown for the Marine Drive area is probably indicative of north bank prices. As it can be seen they are considerably higher than any values on the Main Arm, and they are considerably higher than the comparable shallow draft area near New Westminster. As it was observed this area has attracted most of the new industrial development, and accordingly land prices are higher; and similarily we can suggest that proximity to the central business district is a factor as well. Examining the data for the other areas it can be seen that industrial land prices in the G.V.R.D. appear to

be strongly correlated with proximity to the downtown area. The areas are generally listed in order of increasing travel time from downtown and values generally fall accordingly (Pearson: 1972, graphed them and found they fell almost exponentially with distance). Looking at the Fraser shorelands in Table Eight and the other areas in Table Nine it is readily apparent that shorelands are among the lowest priced industrial lands within the region. Similar waterfront land with a port industry potential in North Vancouver is considerably higher priced than Fraser shoreland, even with the estimated cost of fill included. Property on Annacis Island, one of the regions better industrial estates, is much less than half as valuable as in Lake City Industrial Estate despite its waterfront potential.

Table Nine

Typical Industrial Land Values

(Greater Vancouver Real Estate Board: 1969, 1970)

	1969	1973
Cambie to Main (vicinity 2nd Avenue)	174000-261000	348000-436000
Boundary Road	40000-50000	50000-60000
Marine Drive area	45000-60000	87000-131000
Lougheed at Boundary	45000-55000	70000-85000
Willingdon area	25000-35000	45000-65000
Lake City	45000-60000	70000-160000
North Vancouver (waterfront filled)	30000-50000	80000-100000
Port Coquitlam (not waterfront)	2500-3500	30000-40000
Richmond (not waterfront)	7500-15000	25000-70000

Initially it was hoped that more data could be obtained for a longer time span in order to determine if shorelands were increasing or decreasing in value, but only the two years shown were available. However, it can still be observed that many of the region's non-waterfront areas have more than doubled in value over the past five years, and in Port Coquitlam the gain ranges from 400 to 1000%. In Table Eight it can be observed that shorelands have barely kept pace, and almost no areas showed more than a 60 to 100% gain; the main exception being the Marine Drive area which has gained rapidly. However, the number of non-users in the area suggests that this may be because of its proximity to downtown rather than its waterfront potential.

Thus it can be seen that proximity to the Fraser River has virtually no effect on land values within the region. Shoreland values appear to be determined by proximity to Vancouver's central business district and to some extent New Westminster's. Generally, increases in value have been less than in more central parts of the G.V.R.D. The fact that shorelands on the North Arm, and on the banks of both arms closest to downtown are more valuable than the banks on the opposite side of the River suggests that the River may be acting as something of an impediment to the normal outward expansion of a growing industrial base. It can be argued from this evidence that because shorelands do not now carry a high market value they are not in great demand compared to other locations. The differential in rental value of the shoreland, if market prices can be used as a proxy, may be negative other things being equal. That is, instead of shorelands being more valuable because of waterway access, this factor is heavily outweighed by others.

(6) Summary

A great deal of evidence can be found which indicates that shorelands do not on the whole carry a higher differential value relative to upland sites. A large number of firms do not use its waterway access attribute and industrial settlement is more clearly oriented to the central business district than the waterfront. The River has not been very attractive to new plant locations in the region as only the wood industries and the non-metallic mineral industries favour it consistently. This

observation of low demand for waterway access was strongly reinforced by the realtors survey. While two industry categories noted, as well as port industry, do place a high rental value on shoreland for transportation uses, their competion for shoreland may not be enough to have a significant affect on land values. The wood industry in particular is not growing and the needs of the port industry on the Fraser are not likely to be great. An investigation of land prices, which might be used as an indicator of rental value, demonstrates that shorelands have no special value in the market place, and that proximity to central business districts is far more important for most firms. Therefore, it can be concluded that shorelands on the whole do not carry a higher rental value for waterway access than similar sites inland.

B. SUPPLY AND DEMAND FOR WATERWAY ACCESS: THE SOCIAL OPPORTINTY COST OF UNEMPLOYED RESOURCES

This section will be concerned with indicating the capacity of vacant land designated industrial along the Fraser, and with establishing when that capacity might be exceeded. The approach differs with previous studies of industrial needs for shoreland in that it will focus on shoreline length rather than land area. This approach was undertaken because concern is primarily with waterway access rather than with industrial land, and because of the shortcomings noted in previous studies. These studies will be reviewed before examining the empirical information.

(1) Past Predictions

The results of this investigation have so far indicated that shorelands have very little rental value to most firms. As it has been mentioned, recent studies of future industrial land needs have not reached the same conclusion, and an attempt will be made to account for the difference. Although much outdated, probably the most thorough study of industrial land use and needs was published by the L.M.R.P.B. (1961), and is entitled Dynamics of Industrial Land Settlement. Ten years later the G.V.R.D. published a followup study entitled Space for Industry. Two other relevant studies were done by the B.C. Research Council but these pertain only to the North Arm.

The original L.M.R.P.B. study was largely responsible for the allocations of shoreland to industrial use in the Regional Plan. The results of that study are analyzed in Space for Industry. It was found that overestimates were made in most of the sectors and the reasons cited included increased worker densities (ie., labour and capital substituted for land) as the region shifted from a processing to a fabricating oriented economy, and over optimism on the part of industrialists surveyed. The forecast land absorbtion rate at deep water sites was 73% higher than actually occurred, and at shallow water sites it was 69% higher. Although forecasts of upland use were at least 44% high the waterfront sector was the most exaggerated.

Despite the errors in of the L.M.R.P.B. study, Space for Industry went on to predict a heavy demand for waterfront sites

as well, and it stated that most of the region's shoreland acreage would likely be taken up by the year 2000. Four crude methods were used for prediction: average-population coefficient, land absorbtion rate, employment density forecast, and land per worker coefficient. It was noted that about one-half of the industrially used acreage in metropolitan Vancouver has waterfrontage although it is occupied only by one-tenth of the firms, and that demand for waterfront sites was generally growing apace of the demand for upland sites. The main users were listed as wood industries (sawmilling), fish canning, shipyards, non-metallic mineral industries, and petroleum refineries. Of the list the report predicted wood and petrochemicals would be the main consumers of shoreland. The non-metallic metal industries were predicted to grow slightly and the remaining two not significantly.

An analysis of independent sources, however, indicated that the expansion in the wood industry, to take the most important component, is highly unlikely (Draeske: 1972). Furthermore, some of the predictions based on past trends may be misleading. They were based on experience in the mid-sixties and on projected increased employment which may not necessarily lead to new plant sites. Another possible cause of overestimating the shoreland use is based on the report's observation that nearly one-half of the acreage absorbed between 1960 and 1966 was taken up by water oriented industry. The prediction is based on the assumption that past trends will continue and it is suggested that 35% of the acreage used will be on the waterfront. Because intensity of use is not considered in their estimates of land

absorbtion (ie., the whole site which a plant owns is considered as used) it is possible that the estimates are too high. It was observed that plants frequently do not use the full shoreline length which they own, and frequently only use a small portion of the site area. It is suggested, therefore, that a change in municipal subdivision policy could easily effect the pattern of use and produce a different estimate; and much of the predicted expansion in each sector which was based on employment estimates could occur at existing plants. An additional source of error concerns the possible reuse of land as older plants are demolished and new ones built on the same sites.

In 1958 the B.C. Research Council undertook a study of the future economic activity on the North Arm. At that time it was predicted that virtually all of the north bank and much of the Lulu Island shoreline would be occupied by industry by 1965. However, it was stressed that "new industry will be established in the area chiefly because of the pressure of metropolitan growth and the availability of land, rather than because of the river." The results of their study, based on a questionaire survey of all firms on the banks, identified a number of firms which originally located to use the River for transportation but have since switched to rail or truck (and in particular coastal traffic which now goes by truck and ferry). Several plants which have never used the River said they chose their location because of cheap land, suitable premises, nearness to supplies and customers, or to escape unsatisfactory conditions elsewhere. They noted that undeveloped shoreland areas had no special attraction for industry, other than the forest industry, except

that they were available. Looking back at this report it appears that it has overstated the case in two respects: industrial development has not been as great as predicted, and while non-users of the waterway have been important new shoreland occupiers they have not dominated to the extent predicted.

The second study undertaken by the same organization was directed toward a cost-benefit analysis of widening and deepening the North Arm channel (B.C. Research: 1970). In this study it was noted that many changes have occurred since 1958 but the effect on harbour utilization was small. Activity amongst metal fabricators and the sand and gravel industry is expected to be more important in the future, but in the long term the forest industry will continue to be most important. It was noted that no new mills were likely but production at existing sites was increasing.

The evidence presented in this review is mixed. On the basis of the L.M.R.P.B. and G.V.R.D. studies it would appear that future industrial demand will be great. However, the methodology of Space for Industry was questioned because of its reliance on employment data, past trends and existing site sizes. The two B.C. Research studies appear to indicate a much less important role for the waterway.

(2) Capacity of Shorelands

A number of industrial sectors have been identified which commonly choose waterfront sites. Examples of most of these can be found on the Fraser but the list will be supplemented with others from the rest of the G.V.R.D. and from outside the region. The objective of this analysis will be to determine how much industrial growth could be accommodated on the Fraser shorelands before it would be necessary to utilize the areas which have been identified as major recreation sites. Generally the method simply involved doubling the current length of shoreline occupied, both by users and non-users, for each category in the entire entire G.V.R.D. to give the first alternative, and tripling it to produce a second alternative. Data for this was taken from this study and from Forward (1969), and the results are in Table Ten.

The only exceptions were in the wood industries and the primary metals. In the former strong evidence was found indicating that no new plants were forthcoming in the study area. Accordingly the first figure for wood industries in Table Ten represents the amount needed for a total relocation from Burrard Inlet to the Fraser, and the second figure arbitrarily adds another mile to represent the equivalent of a new mill complex.

The second exception, primary metals, was introduced because it is possible that industries not currently found in the G.V.R.D. may locate in the Region in the future. In a review of information supplied by the American Waterway

Operators Income, primary metals were the only group which seemed to be potential new shoreland occupiers. Other types were discounted because the Fraser is not comparable to an inland waterway in that its traffic is oriented to coastal and deepsea shipping.

Table Ten

Possible Future Shoreland Occupation

(miles of shoreline)

	ALTERN. #1		ALTERN. #2	
	shall.	deep	shall.	deep
food industries		1.5		3
wood industries	1.8		2.8	
paper industries	0.3		0.6	
primary metals		1		2
metal fabricators	1.0	0.5	2	1
trans. eq. (boatbuilding)	0.4	1.4	0.8	2.8
chemical industries	0.6	0.6	1.2	1.2
petroleum industries		2.2		4.4
non-metallic minerals	4.4	1	8.8	2
storage and ware.		1.8		3.6
TOTAL PORT ORIENTED IND.	8.5	10.0	16.2	20.0
water transport		5.9		11.8
TOTAL	8.5	15.9	16.2	31.8

It can be seen from the summary in Table Eleven that all of the existing shoreland use in every category in the region could about double and still be accommodated on Fraser shorelands in

areas with fair to good foundations, and without having to utilize any major recreation sites. If use was to triple all of the port oriented industry could still be accommodated within currently designated industrial areas. In this case, however, the port industry would require more vacant land than is shown. But if one-half of the land previously classified as mixed uses were redeveloped, it could easily be accommodated without having to utilize any major or small recreation sites.

Table Eleven

Vacant Shoreland and its Capacity for New Occupants

(miles of shoreline)

	vacant	alt.#1	alt.#2
shallow port	34.3	8.5	16.2
-good/fair found.	23.0		
-poor/v.poor found.	11.3		
total deep port	25.5	15.9	31.8
-good/fair found.	17.3		
-poor/v.poor found.	8.2		

(3) Rate of Shoreland Occupation

Based on a number of projections of future industrial acreage needed, Space for Industry predicted the study area would exhaust its supply of vacant industrial shoreland by the year 2000. However, because the problem here is more concerned with a possible scarcity of waterway access a number of simple projections of shoreline mileage needed were made. These were based on data used to examine recent trends in plant locations,

and the measurements of length occupied were made on large scale maps. The curves are derived by extrapolating the average annual rates of new occupation.

Figure Seven shows two possible alternatives for shorelands with deep port capability. First, projecting the rate of occupation by all types of activity, it found that sufficient lands were available to about 2022. However, if only uses which actually use deep water access were permitted, sufficient land is available with good foundations to 2042. The total supply would not be exhasted until the end of next century.

Figure Eight indicates that shoreland occupation in shallow port areas could be accomodated to the year 2022 if no regulations were imposed. With restriction to waterway users only, and without any growth in the wood industry, the shorelands could accomodate new plants at least to the year 2052.

Based on these observations it would appear that problems of shoreland scarcity are far off in the future. While straight line projections of this kind must be interpreted with caution, it is likely that they represent upperbounds rather that probable trends. Aside from the abundance of information indicating a declining demand for waterway access, these figures are based on the observed width of a shoreland occupier rather than the actual footage used. Therefore, if plants were more closely spaced by further subdivision of parcels, many more plants could be accomodated per shoreline mile.

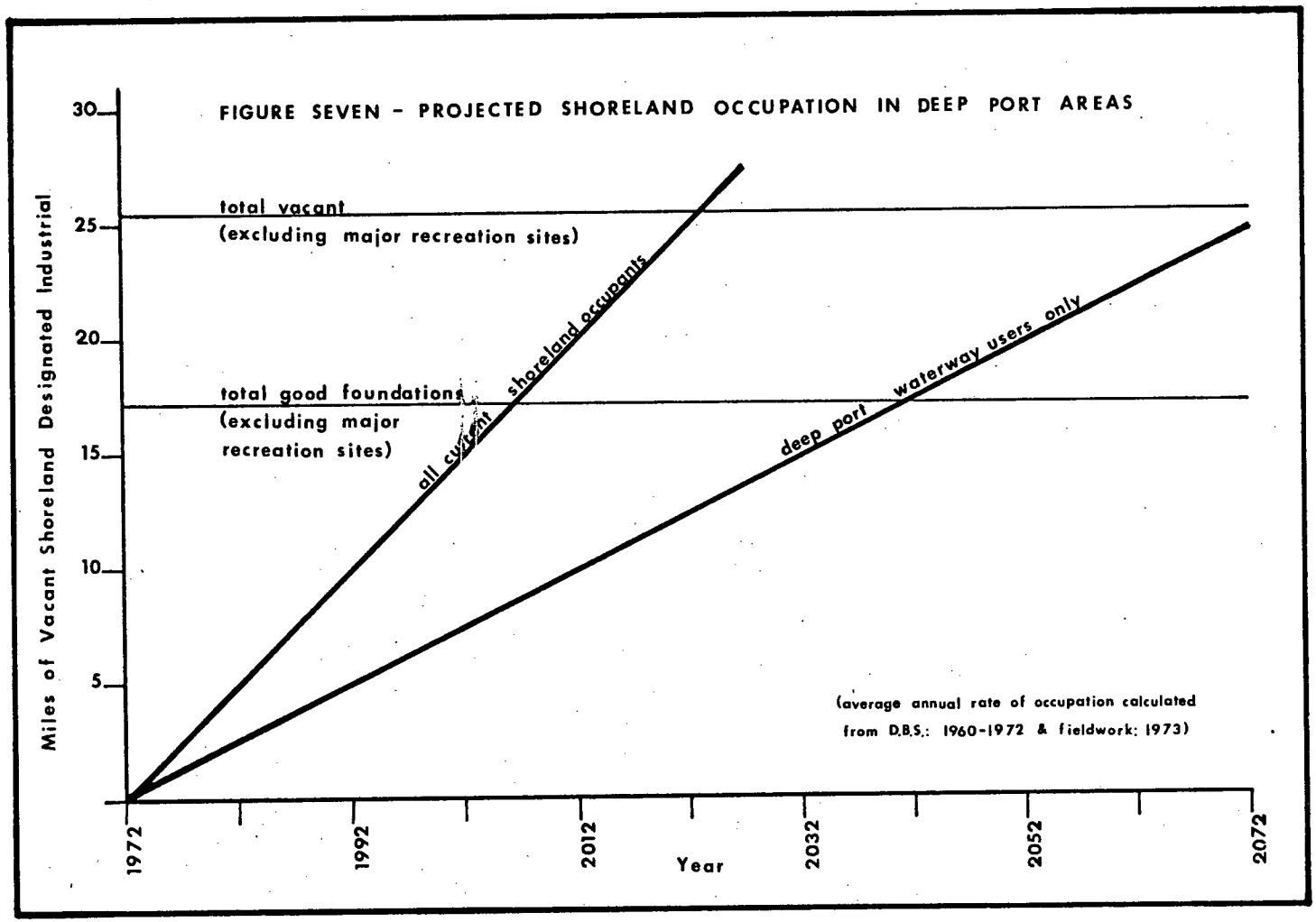


FIGURE SEVEN - PROJECTED SHORELAND OCCUPATION IN DEEP PORT AREAS
Miles of Vacant Shoreland Designated Industrial
30
25
20
15
10
5
total vacant
(excluding major recreation sites)
total good foundations
(excluding major
recreation sites)
all current shoreland occupants
deep port waterway users only
(average annual rate of occupation calculated
from D.B.S.: 1960-1972 & fieldwork: 1973)
1972
1992
2012
2032
2052
2072
Year

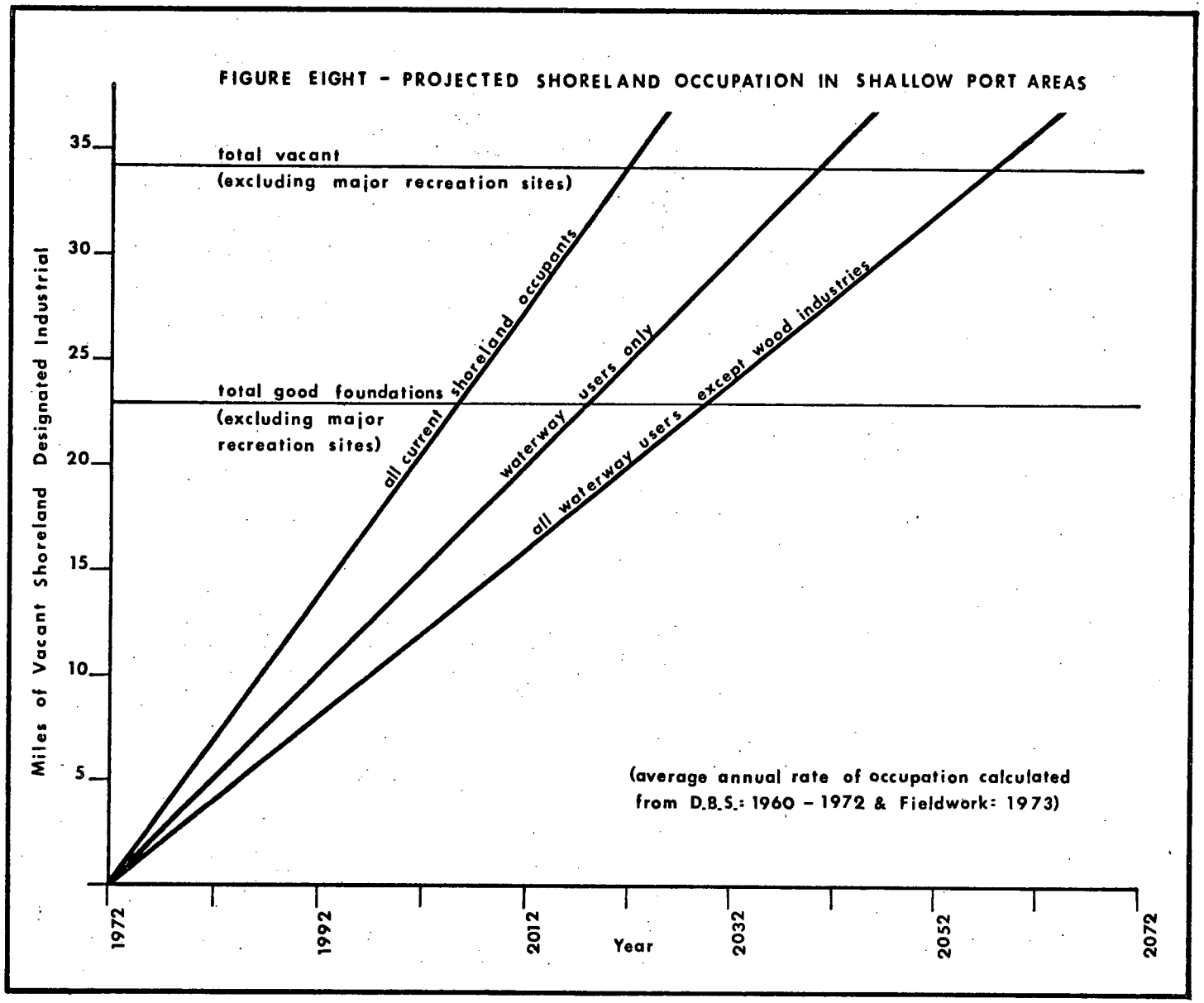


FIGURE EIGHT - PROJECTED SHORELAND OCCUPATION IN SHALLOW PORT AREAS
Miles of Vacant Shoreland Designated Industrial
35
30
25
20
15
10
5
total vacant
(excluding major recreation sites)
total good foundations
(excluding major
recreation sites)
all current shoreland occupants
waterway users only
all waterway users except wood industries
(average annual rate of occupation calculated
from D.B.S.: 1960 - 1972 & Fieldwork: 1973)
1972
1992
2012
2032
2052
2072
Year

(4) Summary

The analysis in terms of length of waterway access strongly indicates that vacant shorelands are not likely to be scarce in the near future. It was found that Fraser shorelands could accomodate a doubling of all existing study area shoreland occupation (including non-waterway users) on vacant lands designated industrial with good foundations, but without including the sites identified for recreation. Simiarily if the poor foundation lands were included, the Fraser could almost accomodate a tripling. However, extrapolation of the current rate of shoreland occupation indicated the Fraser could accomodate growth of all current types of industry found on the shoreland for at least 50 years, in both shallow and deep port areas. If the shorelands were restriced to waterway using activities in all areas, and if deep water using activities were the only uses permitted in deep water areas, the capacity of the shorelands is adequate for at least 80 years. Thus, it can be concluded because there is sufficient shoreland to accomodate industry, at least in the forseeable future, the social opportunity cost of preserving the recreation sites identified is zero in the short run.

C. DEMAND AND SUPPLY OF INDUSTRIAL LAND

In Chapter Five it was found that preservation of all of the major recreation sites would involve the displacement of about 500 acres of land designated industrial in the Regional Plan. The implications of any action to set aside these lands

for recreation are uncertain, but several factors suggest that the effect on the land market would be slight.

Looking at the total supply of industrial land, Space for Industry concluded that the region would not be facing a shortage of industrial land in the future. "It appears that land shortage itself will not be a direct constraint on industrial growth in the region in this century if appropriate policies for reserving and servicing land for industry are actively pursued" (G.V.R.D.: 1971). The report cautions that the region must set aside for industry those sites which are particularily attractive to industry.

On the basis of these findings it would appear that the reduction in total supply is less important than the type of lands which would be taken out of industrial designation. A key ingredient in the attractiveness of land to industry has been its proximity to urban cores. Space for Industry noted that the greatest number of firms and the largest acreages developed were within 30 minutes driving time of downtown Vancouver. Because much of the Fraser, with the exception of the North Arm, is beyond this limit it is not particularily attractive to new firms.

An important consideration of some firms has been the size of parcels available. It was noted that large parcels of land were absorbed in the 30 to 40 minute range of downtown. Because the shorelands tend to be broken into relatively large lots they are attractive to some firms for this reason. However, it was also observed on large scale maps that firms tend to own much

more land than they actually utilize, and that a reduction in parcel size would promote a higher density of use.

Another consideration concerning the attractiveness of industrial land is its foundations. While the recreation sites identified appear to be about equally divided between good and poor foundations, the square areas of these were not computed because no estimates of the total area of good and poor land in the region are available. However, Levesque (1974) has examined the amount of industrial designated land in the region with good foundations, nearby services, and non-agriclutural land reserve status. Although his estimate of 3200 acres of readily available prime industrial land does not include all lands with good foundations, it is useful to note that none of these areas were found on Fraser shoreland recreation sites.

Levesque has also projected the industrial land needs for for the region until the end of the century. Based on his analysis it was found that the region may not require as much industrial land as it was thought at the time the Regional Plan was formulated. Similarily the the forecasting techniques of Space for Industry were criticized earlier, and it was noted that several factors may have lead to an overestimate.

On the basis of the evidence presented it is suggested that industrial land is not scarce in the region, and the removal of only 5% of it will not have a serious effect on the land market in the near future. While some lands on the North Arm are particularily valuable because of their proximity to the urban core, very little recreational land was identified in this area.

Land appears to carry a definite value in less central locations if it is available in large parcels, but it was also noted that parcels were considerably larger than they needed to be. Certain sites might be preserved both for industry and recreation, by simply cutting them parallel to the River at a point a few hundred feet from the high water mark. This would not destroy the upland sites potential for large plants, and it would prevent unnecessary occupation of foreshore by non-waterway using firms.

Chapter Seven

The Social Opportunity Cost of Preserving Recreation Sites: An Analysis of Log Storage Alternatives

The conflict between the log storage activities of the forest industry and the use of a large number of recreation sites was identified as the most immediate problem in Chapter Four. While this activity does not involve the permanent destruction of natural landscapes, it does restrict recreational use of shoreland as several square miles of intertidal foreshore and water lots are covered over by log booms. This reduces the size of available sand bars as well as prevents fishermen from casting their lines.

Although several miles of shoreline are lined with log booms the magnitude of the conflict was not as great as initially expected. Chapter Four revealed that about 6% of the existing storage area would need to be removed to free all key major sites, and about 8% to free all major sites. The purpose of this Chapter will be to examine possible alternatives for freeing recreation sites, and attempt to evaluate the costs of each. As it was outlined in Chapter Five, monetary estimates will be made where necessary to compare three alternatives --

possible relocation, seasonal storage use at certain areas, and bundle booming. Information was obtained largely from interviews with forest industry executives.

A. RELOCATION

The first of two possible relocation alternatives concerned the moving of existing storage area further offshore. Logs are currently stored along the shoreline between the highwater mark and the harbour headline, sometimes extending the full width. Because logs cannot be stored outside of the headline which is drawn to secure adequate space for navigation, companies frequently move logs only at high water times in order to obtain increased width. This practise places severe restrictions on the recreational use of many sites as logs are sitting high and dry on many otherwise attractive sandbars. In order to alleviate this conflict, and a number of less severe conflicts where logs are stored only up to the low water mark, an attempt was made to determine at which sites logs could simply be moved further offshore. However, the results of that investigation were not conclusive. Although it was possible in some situations, additional costs would be incurred in using longer piles to construct dolphins, and in some cases tugboat crews would be reluctant to use these facilities as increased currents near the center make working more dangerous.

The next alternative considered relocation elsewhere in the River. The full storage capacity of the North Arm and much of

the Main Arm has already been fully utilized for several years and the only available space is further up the Pitt River beyond the study area. Sufficient areas are available at mid-channel points and no additional conflicts would be introduced on Pitt shorelands. Using this area as an alternative an attempt was made to calculate the cost of relocating 8% of the storage area.

According to British Columbia Forest Service figures for 1970 to 1972, an average of 480 million cubic feet of logs are towed into the study area from the ocean each year. Because it is not clear which logs are used directly it is difficult to know what proportion would have to be stored in the Pitt. To be on the safe side, if we assume that 8% of the annual total brought into the River were to be stored on the Pitt, this would represent 38.4 million cubic feet, and at 4000 cubic feet per average flat raft section, this represents about 9660 sections. The additional towing costs calculated from Boundary Road in the North Arm to the Pitt are $28 per section, and for the backhaul $17 per section, for a total of $45. At that rate the annual extra towing costs would be $435,000. In addition it would be necessary to construct new dolphins in the first year. If 8% of the total storage area is affected this would amount to 136 acres or 1300 sections. Using a standard 10 piling dolphin at the head of each storage area, 1 pile per section thereafter, and a 4 pile dolphin every fourth section, about $100,000 would be involved (at $120 per pile). Assuming a 9% discount rate over 20 years this would amount to about $11,000 per year. Thus the total annual cost would be about $446,000.

The reliability of this type of estimate is always difficult to ascertain but it is likely to be much higher than need be for a number of reasons: closer storage areas may be found, many booms would not need to be towed so far, and the Pitt could be used more as a reserve area and used less extensively than downstream grounds.

B. SEASONAL STORAGE

The second alternative concerned the timing of boom storage use at recreation sites. Because most outdoor activity takes place in the summer months it was felt that a less intensive use of booming grounds at this time might be taken advantage of by restricting certain grounds. The British Columbia Forest Service maintains monthly statistics on the total number of logs stored in the Main Arm and these were used to construct the graph in Table Twelve. As it can be seen the months from April to August are the least important times for log storage. While a sizable inventory must be kept during the months of April, May and June in order to avoid difficult towing conditions, it does not appear to be nearly so important as the inventory needed to keep mills at full production over the winter months when logging is difficult.

It might be noted, however, that these figures were not as expected for these times of the year because forest company officials stressed the need for high spring inventories. The only reason which was found for this possible decline in

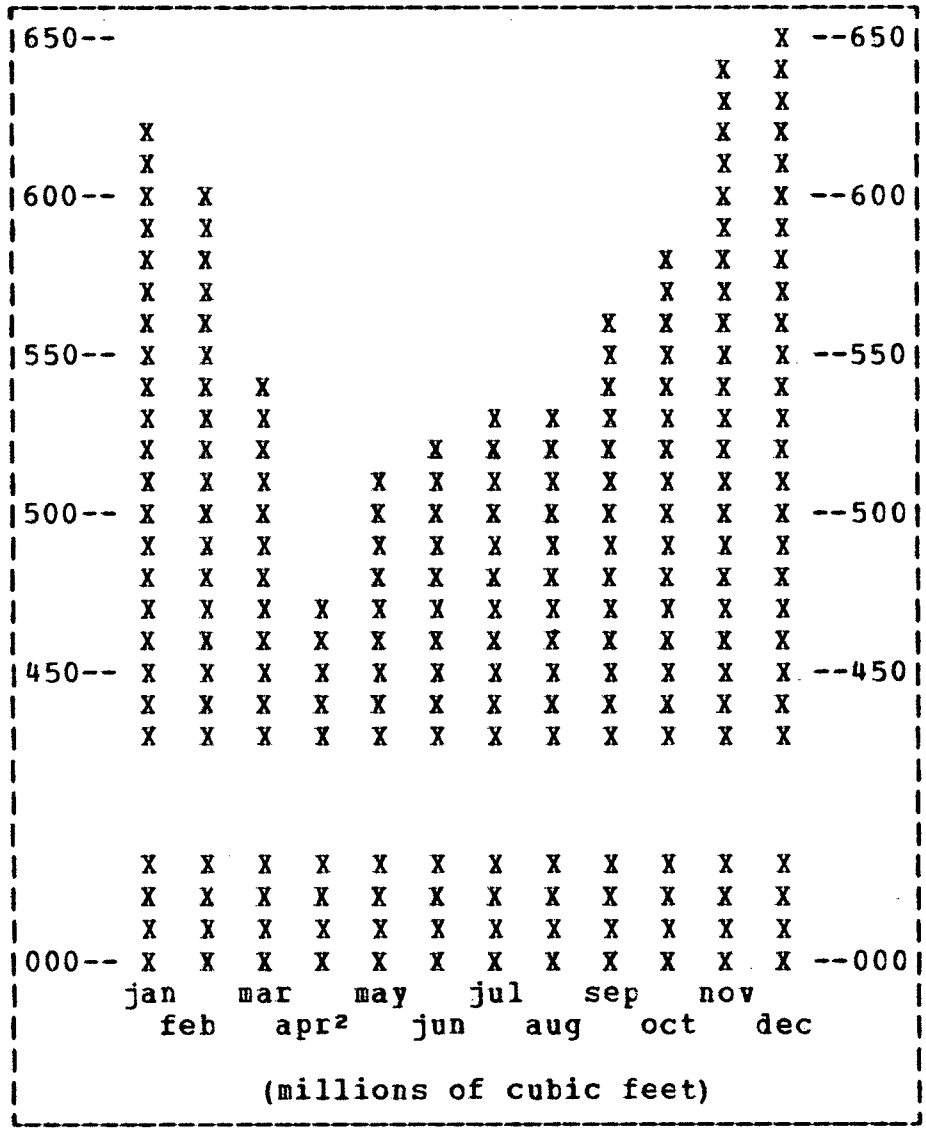
importance is the advent of more powerful tugs which are capable of moving logs upstream at any time of the year.

In any event the summer inventories are of the order of 15 to 20% smaller than the fall and winter inventories. Therefore, forest companies could redirect logs which would normally be stored at recreation sites to other storage grounds during summer months. Table Twelve suggests that no significant costs need to be incurred by the companies involved as less than one-half of the apparent summertime surplus storage area would be affected. A possible means of enforcement might be the granting of log leases which are only tenable from mid-September to mid-March.

Table Twelve

Average Monthly Log Inventory in the Main Arm

(calculated from B.C. Forest Service Figures: 1970-1972[1])



1. data given in board measure was converted using a factor of six
2. an unusually low figure for 1972 made this month appear lower than normal

C. BUNDLE BOOMING

The third alternative considered concerned the possibility of shifting to other types of log handling and storage. The most feasible alternative would involve converting from flat rafts to bundle booms. A thorough study of this type of log handling was made by Fairbairn (1974) and only a general review is necessary.

The main advantage of bundle booms is that a complete changeover could free about 40 to 50% of the total storage area currently in use. Fairbairn calculated the social costs and benefits of a possible conversion and found the benefits to exceed the costs in each of three postualted alternative situations. Similarily, the calculation from a private stance indicated that forest industries would profit by such a move. The main costs include new equipment for boom construction, dredging of shallow storage areas (bundles require up to a 4 foot draught), and the conversion of mills to receive bundles; the main benefits accrue from reduced log loss, reduced towing charges, and fewer delivery delays. The accuracy of this calculation appears to be high as several firms are either considering, or have already begun to switch. However, Fairbairn cautions that his calculations may not apply to some smaller mill operation for which the benefits may not exceed the costs.

These observations would seem to suggest that bundle booming on a major scale is not far off, especially if some form of effluent tax is imposed in order to speed up the process.

This would solve all of the recreation conflict problems outright if Harbour Commissions ensured that grounds at recreation sites were the first to be taken out of service. However, because this may take some years to happen it can be suggested that more immediate action to cancel log storage leases at certain sites, particularily at key recreation sites, would impose very little financial burden on the industry. Much of the cost involved in the changeover can be avoided in the short run.

It has been estimated that about 50% of the storage areas are already deep enough to accomodate bundles, and the benefit-cost ratio of converting some mills immediately is much higher if dredging costs are not included. Therefore, it is argued that several operations can make the change very profitably and the small amount of space needed for recreation easily accomodated. It must be cautioned, however, that some problems of equity may arise if certain companies happen to own a disproportionately large share of the affected booming grounds. Harbor Commission policy in this case would have to ensure that the burden of storage space forgone was shared equitably among the firms involved.

D. SUMMARY

This investigation has identified two alternatives to existing log storage arrangements which might be used to free major recreation sites. The use of seasonal storage leases is particularily attractive in the shortrun because all major sites could be freed from log storage during the summer months without incurring extra production costs. The use of bundle booming storage is most appealing as it would free major recreation sites all year round. Even if full scale conversion is unlikely in the immediate future, partial conversion could be forced on the industry by simply not renewing leases at recreation sites. Because the benefits would exceed the costs to the industry, particularily since dredging would not be required, it cannot be considered as a financial burden on the firms. Therefore, it can be suggested on the basis of this analysis that at least two avenues are open for freeing major recreation sites, and that the benefits forgone if storage at recreation sites is discontinued are negligible.

Chapter Eight

Summary and Conclusions

Fraser shorelands have been the focus of increasing interest on the part of local recreationists seeking tc preserve fishing bars and other natural recreation areas. However, part of the area's waterfrontage is currently taken up by industrial activities, and the Regional Plan has facilitated a continued growth in the industrial use of shoreland by designating the bulk of the largely unused lands for this activity. In addition to concern for indiscriminate development of potential recreation sites for industries, recreationists have also sought to free many recreation sites from the forest industry's log storage activities on the foreshore and adjacent water lots.

In light of these observations this study began with a review of existing institutional arrangements to determine if there was any reason to believe that shoreland was not being allocated to serve the public interest. There is clear evidence that because of the limitations of the private market, public institutions intervene in the allocatien of shoreland. This thesis examines the information needed by decision makers in deciding how shorelands should be allocated, and attempts to

fill some of the gaps in the information currently available.

In deciding whether it is advisable to allocate shoreland to recreational uses, public officials must, in effect, determine whether a given parcel of land will yield greater benefits to society if used for recreation than if it were used for other purposes. Although much of the information necessary for this type of evaluation was collected, weighing the benefits and costs of each alternative shoreland use is a difficult task because of, among other reasons, the problems of evaluating recreational use. Confronted with this difficulty this thesis focuses upon the benefits society would forgo if certain shorelands were allocated to recreation. These benefits forgone are referred to as the "social opportunity cost" of preserving specified sites for recreation uses. This chapter will summarize the steps taken in the examination of social opportunity cost and draw some conclusions based on it.

It is important to undertand throughout the study that an analysis of social opportunity cost does not answer all of the questions a decision maker might want answered. The value of recreation benefits may still need to be determined in order to make a comparison with the social opportunity cost estimate. However, knowing something of the social opportunity cost at the outset makes the task much more manageable.

A. IDENTIFICATION OF RECREATION SITES

For an evaluation of social opportunity cost to be meaningful it was necessary to begin by identifying potential recreation sites which might be worth preserving. Such an inventory is also useful because recreational use of the Fraser has been a recent and localized concern and very little is known about its recreation potential.

In order to undertake the inventory it was necessary to begin with an examination of previous approaches in other areas. It was found that some degree of subjective evaluation was necessary in order to provide sufficient detail to make the inventory meaningful. Accordingly, specific criteria were developed for each possible activity from a review of the literature. Information was generated from a review of recent reports and interviews with knowledgable informants, as well as from extensive field investigations.

Four types of recreation sites were identified in the inventory. A total of 32 sites were classified as major sites, and of these nearly one-half were judged as key major sites (or well above average). Most of the major sites were suitable for beach activity, but the most important use was for sand bar fishing. Other activities such as beachcombing and viewing contributed to the attractiveness of the better than average sites. The third category of sites involved less intensive uses than the major sites, and these included pleasure driving, cycling, and walking for pleasure. A series of small sites were identified, mainly on the North Arm, which afforded views of the

River.

B. CONFLICTS WITH INDUSTRIAL NEEDS

In order to assess the nature and extent of existing and potential conflicts with industrial use it was necessary to begin with a survey of current shoreland use. Quantitative measurement found that shorelands were essentially vacant or agricultural in aspect. Only about one-quarter of the shoreland is built upon, and of that about 40% is taken up with low intensity uses such as fishing sheds or storage yards. However, because the Fraser has a rather unique role in providing a transport medium and storage area for logs, analysis based only on use by permanent plant structures is misleading. In all but the lower reaches of the Main Arm log storage occupies several acres of water lots and intertidal foreshore. While this use does not involve the permanent destruction of upland landscapes in the same way that a factory site may, it was found to be an impediment to shoreland recreationists.

The identification of conflicts, therefore, examined conflicts with fixed industrial activities on the one hand, and with log storage on the other. The former was the most important, but the main concern was with potential rather than existing uses. Because the Regional Plan has designated most of the study area shorelands for industry, about two-thirds of the major recreation sites fell in these areas. It was found that about 10% of the shoreline mileage designated for industrial

uses was suitable for major recreation sites.

Two other factors influence the location decisions of new plants: channel characteristics and foundations. Areas suitable for both deep and shallow port use, and the foundations in each, were identified for the shorelands designated industrial. The most important conflict identified in this investigation was with shoreland suitable for port and port oriented industry with good foundations. The amount of shoreline needed to preserve recreation sites in areas suitable for shallow draft or port oriented industry was comparatively small.

A separate analysis of conflicts in terms of total land area was also undertaken. It was found that preservation of all major sites would require about 500 acres, or 5% of the region's supply of land designated industrial.

An analysis of existing conflicts between recreation areas and log storage was conducted from maps showing the size of water lot leases. At each major site the minimum storage area that would need to be removed in order to free that site for recreational use was calculated. Individual estimates were totalled and it was found that less than 8% of the total storage area would have to be forgone in order to free all of the sites.

The conclusion of this investigation was that industrial-recreational shoreland use conflicts mainly involve future use by new plants and existing use for log storage. Because very little upland area is involved, the analysis identified conflicts with industrial land, channel

characteristics and foundation conditions in terms of shoreline length. The largest potential conflict was with land suitable for port industrial use. Conflict with log storage involved about 8% of the total storage area.

C. ANALYTIC FRAMEWORK

In order to provide decision makers with needed information for shoreland allocation decisions, a review of possible approaches was undertaken to determine the best direction for this study. The approach adopted was to examine the opportunity cost of allocating shorelands to recreational use. Of particular concern was the assumption that there is a scarcity of shoreland for industrial purposes. The opportunity cost approach asks the question, what in fact is given up by allocating land to one use as opposed to another. Because shorelands were considerd to be valuable by the Regional Plan, this suggests that many firms attach a rental value to shorelands in excess of the rental value they attach to upland sites with similar foundation and servicing attributes.

Because of the concern for possible scarcity of shorelands, it is important to understand the factors which influence the rental values firms attach to shorelands. A review of industrial location literature revealed that waterway access may be important to some types of firms, but that factors of proximity, parcel size, and foundations may be more important elements in the rental value of shorelands. A sizable body of

literature also suggested that firms are indifferent among a variety of locations.

Of three possible methods of assessing the opportunity cost of not developing shorelands, Lind's approach to measuring the rental value difference between shoreland and upland sites was most appealing. It involves the forcasting of land uses, and a comparison of costs and savings of several factors which affect productive activites at different locations - such as foundations, waterway access, proximity to urban cores and so on. However, this approach was not utilized becuase it was designed for a short term evaluation of firms which would move into a well defined area as soon as a measure was taken, in his example, to protect a flcodplain. In the Fraser shorelands the main concern is with a much less predictable demand for waterway access over a long period of time, and over a wide area. Therefore, it was concluded that the best course of action which can be undertaken at this time is a qualitative evaluation of social opportunity cost.

The approach which was used is based on a review of the supply and demand for shoreland. First, the demand and supply of waterway access was considered. The main thrust of this analysis was to determine the rental value difference between shoreland and upland sites, and the areal and temporal limits of the shoreline. Second, the impact of a reduction in the region's supply of land designated industrial was considered in the context of when currently vacant land would be in demand. And third, the costs of alternative log storage arrangements

were evaluated.

D. THE SOCIAL OPPORTUNITY COST OF PRESERVING RECREATION SITES

(1) Rental Value of Waterway Access

In the review of industrial location literature it was observed that transportation costs are playing a declining role in the siting of new plants. Changing attitudes demanding speed and flexibility, and ultra-efficient port facilities are becoming more important than direct waterway shipping by individual plants. An examination of related location factors found that firms may attach an important rental value to shorelands for such non-waterway oriented reasons as large lots, good foundations, and proximity to urban cores. Another body of literature was consulted which strongly indicated that firms attach very little rental value to particular locations regardless of site attributes. In the examination of five indicators of demand of waterway access, the above observations appeared to be accurate.

It was found that industrial occupation of shorelands was not great. A sizeable number of activities make nc use of the waterway for transportation although they occupy a shoreland site. The North Arm was favoured, especially among non-waterway users, suggesting that other location factors may be important, and that deep draft port oriented industrial use was relatively minor compared to shallow draft.

The Fraser shorelands have not been a major attractive force on new firms locating in the G.V.R.D. Most of the firms which did locate on the Fraser were attracted to shallow draft areas and the wood industries and non-metallic mineral were most important. The North Arm was the favoured location but a large number of new plants did not use the waterway.

The survey of industrial realtors found that shoreland sites were not essential to most types of industry, and surprisingly, they were not even preferred by many which have been observed to locate on shoreland. It was also noted that location decisions were generally made after very little deliberation and strongly influenced by personal preference.

Two important waterway access using industries were considered specifically, port industry and wood products. It was found that because of containerization and relatively low general cargo volumes, port industry would likely not exert a great deal of pressure on the available supply of shoreline. The growing bulk port demands for shoreland can not be accommodated because of draft limitations. The largest user of shoreland in the past has been the wood industry, but the fixed supply of available timber will prevent the establishment of new mills in the region.

An examination of the market values of shorelands revealed that on the Main Arm they are among the lowest in the region. Higher values on the North Arm may be a result of urban pressures rather than the River itself. Thus shorelands in general have not been in great demand.

(2) Supply and Demand of Waterway Access

Studies by the L.M.R.P.B. (1961) and the G.V.R.D. (1971) strongly indicated that shorelands were in short supply in the region. While the former was instrumental in the formulation of the Regional Plan, its predictions of industrial needs for land were well in excess of those which were actually realized. In spite of this finding which was recognized in the G.V.R.D. study, the same study went on to predict heavy industrial shoreland needs based on projections of employment and related factors.

However, these predicitons based on past trends, and assuming a constant subdivision plan, have dubious validity. A different approach to inventory and projection was used in this thesis. It was found that Fraser shorelands could accommodate a doubling of all existing study area shoreland cccupation (including non-waterway users) on vacant lands designated industrial with good foundations, but not including the sites identified for recreation. Simiarily if the poor foundation lands were included, the Fraser could accommodate almost a tripling of existing use.

Furthermore, extrapolation of the current rate of shoreland occupation indicated the Fraser could accommodate growth of all current types of industry found on the shoreland for at least 50 years, in both shallow and deep port areas. If the shorelands were restricted to waterway using activities in all areas, and if deep water using activities were the only uses permitted in deep water areas, the capacity of the shorelands is adequate for

at least 80 years.

(3) Supply and Demand for Industrial Land in the G.V.R.D.

To put the Fraser shoreland designated industrial in a regional context, the preservation of recreation sites along the Lower Fraser would involve a very small acreage of land designated industrial. Recent studies indicate the region is well supplied with industrial land to the next century. Because Fraser shorelands are generally in non-central areas they are less attractive to industry than locations closer to downtown. Although they are valued by some for their large parcels of land, the dimensions of many of these could be reduced to accommodate both industry and recreation.

(4) The Opportunity Cost of Freeing Recreation Sites of Log Storage

Three main alternatives were considered for alleviating the conflict at recreation sites. Consideration of possible relocation of booms further upstream found that additional annual costs approaching one-half million dollars might be incurred. A system of seasonal leases could be imposed at recreation sites without reducing the total downstream storage capacity needed at a given time. Because the total number of logs stored in the summer months is lower than in winter, they could be stored only in areas of little recreation potential during the summer. If firms were to switch to less space consuming bundle boom storage, the recreation sites could be freed because far less area would be required for storage.

While full scale conversion to this type of booming is unlikely in the immediate future, partial conversion could be forced on the industry simply by not renewing water lot leases at recreation sites. Because the benefits of bundle booms, particularily in reduced log loss, would exceed the costs, such a conversion would not entail a net opportunity cost.

E. CONCLUDING OBSERVATIONS

It can be concluded, based on the inventory of potential recreation sites, that the Fraser offers several very good opportunities for the development of recreation sites. The main asset of the River is its wide intertidal foreshores which can be used by bar fishermen, picnickers and beachcombers if upland access and facilities are provided.

If these sites were to be preserved, the results of this investigation have provided clear evidence that the social opportunity cost of doing so is very near zero, at least in the near future. First, an examination of existing use, recent trends, firm preferences and market values demonstrates that most firms do not attach a greater value to shoreland than to similar upland sites. Second, an analysis of the supply and projected needs for shoreland indicates that the opportunity cost of using for recreation these lands which are not currently employed is zero in the short run. Third, a review of the region's supply of industrial land found that the recreation sites occupied an insignificant portion of those lands which

might be needed in the future. Fourth, an examination of log storage alternatives indicated that at least two alternatives could be used to free recreation sites without incurring any social opportunity costs.

While these conclusions have been strongly supported by empirical evidence, it has been emphasized that this information alone is not sufficient for decision making. However, because the short-run opportunity cost is zero, decision makers have time to acquire and develop certain sites for recreation on an experimental basis. This would produce a clearer picture of the actual demand for Fraser sites by recreationists, and enable a more reliable estimate of the value of this demand to be made should it become necessary to make a benefit-cost evaluation with industrial demands as land becomes scarcer in the future. Such estimates would also be necessary to ensure that funds used to acquire Fraser shorelands were being spent to maximize the returns on public investment in recreation. Because the expenditure of funds to acquire land entails an opportunity cost, in that an alternative purchase must be foregone, some idea of the relative value of the Fraser compared to other potential recreation areas would still be needed for efficient decision making.

Bibliography

Adams, Neale. 1973. "Can We Achieve Zero Population Growth". Vancouver Sun. August 16, p 6.

Alonso, William. 1964. Location and Land Use. Harvard University Press, Cambridge.

Apedaile, M.D. 1972. "Canadian Exporter Boxes Newsprint and Paper Rolls". Unreferenced xerox copy.

Arvanitidis, N.V., et.al. 1972. A Computer Simulation Model for Flood Plain Development -- Part 1: Land Use Planning and Benefit Evaluation. INTASA Consultants, U.S. Department of Commerce, Washington.

Alonso, W. 1967. "A Reformulation of Classical Location Theory and its Relation to Rent Theory". Papers, Regional Science Association. Volume 22, pp 149-153.

Ayres, R. and Kneese, A. 1969. "Production, Consumption and Externalities". American Economic Review. Volume 59, pp 282-297.

Bator, F.M. 1960. The Question of Government Spending. Collier Books, New York.

Barloon, M. 1965. "The Interrelationship of the Changing Structure of American Transportation and Changes in Industrial Location". Land Economics. Volume 41, pp 169-179.

Beaulieu, A.G and Maxwell, J. 1972. "Notes on Land Use and Land Planning". Coastal Zone: Volume 1, Selected Background Papers. Edited by Environment Canada, Ottawa.

Belknap, R. and Furtado, J. 1965. Three Approaches to Environmental Resource Analysis. Landscape Architectue Research Office, Graduate School of Design, Harvard University.

British Columbia, Department of Industrial Development, Trade and Commerce. 1960-1972. Industrial Expansion in British Columbia.

British Columbia. 1971. Municipal Act. Victoria.

British Columbia, Department of Industrial Development, Trade and Commerce. 1972. The Sawmill Industry of British Columbia.

British Columbia Forest Service. 1970, 1971, 1972. Monthly statistics of logs stored in the Main Arm; supplied by B. Fairbairn.

British Columbia Hydro and Power Authority. 1963. Potential Deep Sea Industrial Sites in Southwestern British Columbia. Industrial Development Department.

British Columbia, Parks Branch. 1972. Lower Mainland Park Objectives Study. Victoria.

British Columbia Research Council. 1970. Benefit-Cost Study of an Enlarged North Arm Channel. Vancouver.

British Columbia Research Council. 1967. Vancouver Harbour: Traffic Trends and Facilty Analysis. A study prepared for the National Harbours Board.

Brown, R. 1971. The Natural Outdoor Recreation Resources of Muskoka: An Approach to the Inventory and Evaluation of Outdoor Recreation Resources. MA thesis, University of Waterloo.

California, Department of Navigation and Ocean Development. 1971. Approaches Toward a Land Use Allocation System for California's Coastal Zone. Gruen and Gruen and Associates, Los Angeles.

Canada, Dominion Bureau of Statistics. 1960-1972. New Manufacturing Establishments in Canada. Published annually by Information Canada, Ottawa.

Canada, Dominion Bureau of Statistics. 1970. Standard Indusrial Classification Manual. Information Canada, Ottawa.

Canada, Dept. of Regional Economic Expansion. 1969. The Canada Land Inventory. "Land Capability Classification for Outdoor Recreation", Report no. 6.

Chapin, F. 1965. Urban Land Use Planning. University of Illinois Press, Urbana.

Chinitz, B. 1964. "City and Suburb". City and Suberb: The Economics of Metropolitan Growth. Edited by B. Chinitz. Prentice-Hall, Englewood Cliffs.

Christian, C. 1957. "The Concept of Land Units and Land Systems". Proceedings of the Ninth Pacific Science Congress. Volume 20, pp 74-81.

Clawson, M. and Knetsch, J. 1966. Economics of Outdoor Recreation. Resources for the Future, Johns Hopkins Press, Baltimore.

Conklin, H. 1960. "Principles of Land Classification". Papers of the Land Economics Institute, Modern Land Pclicy. Irbana: University of Illinois Press, pp 337-343.

Draeseke, G.L. 1972. "Shoreline Management -- an Industry Perspective". A paper presented to the Westwater Forum, October 20th.

Employer's Council of British Columbia. 1969. Limitations and Attractions of British Columbia for Industry. Vancouver.

Fairbairn, B. 1974. Sawlog Pollution in the Lower Fraser River. MA thesis, School of Community and Regional Planning, U.B.C., Vancouer.

Farina, J. 1961. "The Social and Cultural Aspects of Recreation". Resources for Tomorrow. Conference Background Papers, Volume 2, Ottawa.

Forward, C. 1968. Waterfront Land Use in Metropolitan Vancouver, British Columbia. Geographical Paper Number 41, Department of Energy Mines and Resources, Ottawa.

Frankel, E. 1968. "Containerized Shipping and Integrated Transportation". Proceedings of the IEEE. Volume 56, pp 712-722.

F.R.H.C., Fraser River Harbour Commisssion. 1971. Map series 500 feet equals one inch, 1000 feet quals one inch, 300 feet equals one inch.

Friedman, J. 1964. Regional Development in Post Industrial Society - Some Policy Considerations. MIT Press, Cambridge.

Friedrich, C. 1965. Alfred Weber: Theory of the Locatien of Industries. University of Toronto Press, Toronto.

Goldberg, M. 1969. Intrametropolitan Industrial Location. Center for Real Estate and Urban Economics, Berkely.

Goldie, C.C. 1967. Pollution in the Fraser River. Department of Lands , Forests and Water Resources, Victoria.

Greater Vancouver Real Estate Board. 1969-1973. Real Estate Trends. Published annually. Vancouver.

G.V.R.D., Greater Vancouver Regional District. 1971. Space for Industry. Vancouver.

G.V.R.D., Greater Vancouver Regional District. 1973. "Report of the Recreation Policy Committee to the Planning Committee of the Greater Vancouver Regional District". Completed for the Livable Region Program, Vancouver.

G.V.R.D., Greater Vancouver Regional District. 1973. "Population Forecast". Pamphlet, Vancouver.

Gray, J. 1969. The Character and Pervasiveness of Transport Competition in the Movement of Commodities From Greater Vancouver Origins to British Columbia Destinations. MA thesis, U.B.C.

Haig, R.M. 1926. "Toward an Understanding of Metroplis". Quarterly Journal of Economics. Volume 40, pp 421-423.

Halladay, D.R. and Harris, R.D. 1972. A Commitment to the Future: A Proposal for the Protection and Management of the Fraser Wetlands. Department of Recreation and Conservation, Victoria.

Hardwick, W.G. 1961. "Changing Logging and Sawmilling Sites in Coastal British Columbia". Readings in Canadian Geography. Edited by Robert M. Irving (1968), Holt, Rinehart, and Winston, Toronto, pp 333-340.

Haveman, R.H. and Krutilla, J.V. 1968. Unemployment, Idle Capacity, and the Evaluation of Public Expenditures. Resources for the Future, Baltimore.

Hills, G. 1961. The Ecological Basis for Land Use Planning. Research Report No. 46, Ontario Department of Lands and Forests, Toronto.

Hodge, G. 1970. "Patterns and Parameters of Industrial Location in the Toronto Urban Field". Research Paper Number 28, University of Toronto.

Hoover, E. 1948. The Location of Economic Activity. McGraw-Hill, New York.

Hunker, H. 1958. Industrial Evolution of Columbus, Ohio. Bureau of Business Research, Monograph Number 93, The Ohio State University.

Hutchison, Bruce. 1950. Rivers of America: The Fraser. Clark, Irwin. Toronto.

James, L.D. 1965. "Nonstructural Measures for Flood Control". Water Resources Research. Volume 1, pp 9-24.

Karaska, G. 1969. Locational Analysis for Manufacturing. MIT Press, Cambridge.

Kerr, D.P. and Field, N.C. 1968. Geographical Aspects of Industrial Growth in the Metropolitan Toronto Region. Department of Treasury and Economics, Toronto.

Knetsch, J. and Davis, R. 1966. "Comparison of Methods for Recreation Evaluation". Economics of the Environment. Edited by Dorfman and Dorfman, New York, 1972, pp 384-402.

Koopmans, T.C. and Beckmann, M. 1957. "Assignment Problems and the Location of Economic Activities". Econometrica. Volume 25, pp 53-76.

LaForest, G.V. 1969. Natural Resources and Public Property Under the Canadian Constitution. University of Toronto Press. Toronto.

Leiren, Hal. 1973. "Public Right to Fraser Waterfront Recognized". Vancouver Sun. April 16, pp 27.

Levesque, E. 1974. Impact of the Knight Street Bridge on the Allocation of Industrial Land. M.A. Thesis, School of Community and Regional Planning, U.B.C., Vancouver.

Lewis, P. 1964. "Quality Corridors for Wisconsin". Landscape Architecture Quarterly. January, pp 100-107.

Lind, R.C. 1967. "Flood Control Alternatives and the Economics of Flood Protection". Water Resources Research. Volume 3, pp 345-357.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1961. Dynamics of Industrial Land Settlement. New Westminster.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1963. Chance and Challenge. New Westminster.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1966. A Regional Parks Plan for the Lower Mainland. New Westminster.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1966. The Lower Mainland Regional Plan. New Westminster.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1968. Our Southwestern Shores. New Westminster.

Luttrell, W. 1962. Factory Location and Industrial Movement. London.

Macmillan, T. 1965. "Why Manufacturers Choose Plant Locations vs. Determinats of Plant Locations". Land Economics. Volume 41, pp 239-246.

Macnab, G.F. 1965. "A Preliminary Recreation Survey of the Fraser River". British Columbia Department of Recreation and Conservation, mimeo.

Mishan, E. 1971. "The Postwar Literature on Externalities: An Interpretative Essay". Journal of Economic Literature. Volume 9, pp 1-28.

Moses, L. and Williamson, H. 1967. "The Location of Economic Activity in Cities". Papers and Proceedings - American Economic Review. Volume 57, pp 211-222.

Mueller, E. et.al. 1961. Location Decisions and Industrial Mobility in Michigan. University of Michigan Press, Ann Arbor.

N.F.H.C., North Fraser Harbour Commission. 1967. Map series 200 feet equals one inch.

Nishioka, H. and Krumme, G. 1973. "Location Conditions, Factors and Decisions: An Evaluation of Selected Location Surveys". Land Economics. Volume XLIX, pp 195-205.

O'Riordan, T. 1971. Perpectives on Resource Management. Pion Limited, London.

O.R.R.R.C., Outdoor Recreation Resources Review Commission. 1962. Prospective Demand for Outdoor Recreation. Report No. 19, Washington.

Pearse, P.H. 1968. "A New Approach to the Evaluation of Non-Priced Recreational Resources". Land Economics. Volume 64, pp 87-99.

Pearson, Norman. 1972. The Fraser River Harbour Development Study. Fraser River Harbour Commission, New Westminster.

Pearson, Norman. 1973. Operation Open Space. A discussion paper prepared for the Greater Vancouver Regional District.

Peiluck, R. 1967. The Classification System Designated for the Recreation Sector of the Canada Land Inventory Project. MA thesis, University of Manitoba.

Pred, A. 1964. "Intra-Metropolitan Location of American Manufacturing". Annals of the Association of American Geographers. Volume 54, pp 165-180.

Probst, A. 1967. "Criteria for Location of Industrial Plants". Economist Commission for Europe. United Nations, New York.

Rees, W. 1972. "Inter-Institutional Policy Simulator". Water Resources Sub-Group, I.I.P.S., Resource Science Center, UBC.

Ross, Ian. 1970. "Some Aspects of Modern Port Development". A paper presented to the "Saint John Port Day".

R.S.B.C. Revised Statutes of British Columbia.

Richmond, G. 1973. An Analysis of Manufacturing Location in Greater Vancouver. MA thesis, School of Community and Regional Planning, UBC.

Rimes, L. 1971. "B. C. Lumber Shipments are Containerized". Canadian Transportation and Distribution Management. October, pp 29-32.

Robinson, Joan. 1965. The Economics of Imperfect Competition. Macmillan and Company, London.

Smith, D. 1966. "Theoretical Framework for Geographical Studies of Industrial Location". Economic Geography. Volume 42, pp 95-113.

Solzman, D. 1966. Waterway Industrial Sites: A Chicago Case Study. University of Illinois, Chicago.

S.C. Statutes of Canada.

Steed, G. 1972. "Intrametroplitan Manufacturing: Spatial Form and Locational Dynamics in Greater Vancouver". Unpublished draft.

Steinitz, C., et.al. 1969 A Comparative Study of Resource Analysis Methods. Graduate School of Design, Harvard University, Cambridge.

Steinitz, C., et.a. 1970. "A General System for Environmental Resource Analysis". Public Land Policy and the Environment: Part III Environmental Quality and the Public Lands. Landscapes Inc., Madison, Wisconsin, National Technical Information Service, U.S. Dept. of Commerce.

Stewart, G. 1968. Land Evaluation. Macmillan of Australia, Melbourne.

Swan-Wooster Engineering. 1972. A confidential study of the feasibility of locating an industrial firm in the study area.

Townroe, P. 1971. Industrial Location Decisions. University of Birmingham, Birmingham.

Turner, R. 1971. "General Theories of Plant Location: A Survey". American Industrial Development Council Journal. Volume 6, pp 21-36.

Turvey, R. 1957. The Economics of Real Property: An Analysis of Property Values and Patterns of Use. Allen and Unwin, London.

United States, Forest Service. 1959. Workplan for the National Forest Recreation Survey - A Review of the Outdoor Recreation Resources of the Natioanl Forests. Division of Recreation, Forest Service, Dept. of Agriculture, Washington.

Vernon, R. 1960. Metropolis 1985. Harvard University Press, Cambridge.

Watmough, Don. 1972. Shady Island: A Natural History. Richmond Nature Park.

Wersta, E. 1973. Proposal for Bar Fishing Within the Fraser River Delta. Lower Mainland Regional Wildlife Association.

Persons Consulted

Mr. Stuart Adams	(Planner) City of Vancouver
Mr. Tom Boyle	Macaulay, Nicolls, Maitland and Company
Mr. Ken Cheesman	Block Brothers Realty
Mr. Doug Copp	General Realty Limited
Mr. Rick Hankin	(Planner) Greater Vancouver Regional District
Mr. S.B. Hobbs	Geoff Hobbs and Associates
Mr. Jim Holdom	Flack-Holdom Investments
Mr. H. Keenlyside	Penny and Keenlyside Appraisals Limited
Mr. Charles Logan	Macaulay, Nicolls, Maitland and Company
Mr. Ted Lyne	Industrial Development Division, Canadian National Railways
Mr. K.J. MacEwan	(Secretary) North Fraser Harbour Commission
Mr. F.C. MacKay	(Industrial and Trade Commissioner) Department of Industrial Development, Trade and Commerce
Mr. Scott McLaren	(Secreatary) Fraser River Harbour Commission
Mr. Alex McRone	(Manager, Log Allocation) MacMillan Bloedel Limited
Mr. Howie Magee	(Industrial Development Representative) British Columbia Hydro and Power Authority
Mr. Roger Montgomery	Wall and Redekop Limited
Mr. Ted Newman	Block Brothers Realty
Mr. J.H. Norton	Norton Realty
Mr. M.F. Painter	(Manager, Forestry and Logging Division) Council of Forest Industries of British Columbia
Mr. Will Paulick	British Columbia Wildlife Federation

APPENDIX I

Sources of Information for the Inventory of Potential Recreation Sites

Adams, Stewart. Planner, City of Vancouver. Personal interview.

Beach, Dorthy. Save Our Shores Committee. Personal interview.

Canada Land Inventory. 1967. Preliminary Maps of Recreation Potential. Sheets 92G/3 and 92G/2.

Chaster, J.B. Planner, City of New Westminster. Personal interview.

Halladay, D.R. and Harris, R.D. 1972. A Commitment to the Future: A Proposal for the Protection and Management of the Fraser Wetlands. Department of Recreation and Conservation, Victoria.

Hankin, Rick. Planner, Greater Vancouver Regional District. Personal interview.

Kowalenko, S. 1973. "Recreation Study of the Coquitlam-Port Coquitlam District". Draft of a report completed for a Local Initiatives Grant.

Leiren, Hall. Columnist, Vancouver Sun. Personal interview.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1966. A Regional Parks Plan for the Lower Mainland. New Westminster.

L.M.R.P.B., Lower Mainland Regional Planning Board. 1968. Our Southwestern Shores. New Westminster.

McLaren, Scott. Secretary, Fraser River Harbour Commission. Personal interview.

MacNab, G.F. 1965. "A Preliminary Recreation Survey of the Fraser River". Department of Recreation and Conservation. Victoria.

Paulick, Will. B.C. Wildlife Federation. Personal interview.

Pearson, Norman. 1973. Operation Open Space. A discussion paper prepared for the Greater Vancouver Regional District.

Straight, Lee. Fishing Guide. Map of local fishing bars, Vancouver Sun Publishing.

Teissen, Eric. Planner, City of Coquitlam. Personal interview.

Vancouver, Planning and Civic Development Department. Information sheets on possible waterfront parks east of Angus Drive.

Vancouver, Planning and Civic Development Department. 1973. Information sheets on the area at the foot of Angus Drive; compiled for purposes of possible recreation development.

Watmough, D. 1972. An Ecological Approach to the Development of the Richmond Foreshore. Richmond Nature Park, Richmond.

Watmough, D. 1972. Shady Island: A Natural History. Richmond Nature Park, Richmond.

Watmough, D. 1973. A Proposal for Recreation in Macdonald Slough. Draft of a report completed for a Local Initiatives Grant.

Watmough, Don. Authour of several recent recreation studies on the lower Fraser. Personal interview.

Wersta, E. 1973. Proposal for Bar Fishing Within the Fraser River Delta. Lower Mainland Regional Wildlife Association.

APPENDIX II

Recreational Site Report

1. Location
   - (a) site no.
   - (b) map ref.
   - (c) name or description
   - (d) surrounding land use

2. Site Description
   - (a) topography
   - (b) vegetation
   - (c) soil
   - (d) services
   - (e) water quality
   - (f) man-made features
   - (g) particular features
   - (h) view

3. Accessibility
   - (a) roads
   - (b) trails
   - (c) parking
   - (d) proximity to residential areas

4. Recreation Use
   - (a) present

(b) pctential

5. Conflicts
   (a) at present

   (b) pctential

6. Land Tenure

7. Additional Information

8. Data Sources

APPENDIX III

Industrial Realtors Questionaire

INSTRUCTIONS:
1. In the spaces provided please list the ten most important factors which influence an industry's decision to locate on a specific site. Begin with the most important and end with the least important.
2. Place an "E" beside those factors which you consider to be absolutely essential.
3. Feel free to qualify your answers on the back of this sheet.

Food and Beverages
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Chemical and Chemical Products
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Wood Industries
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Petroleum and Coal Products
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Paper and Allied Industries
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Non-metallic Mineral Products
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Metal Fabricating Industries	Wholesale Trade and Storage
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.