EXAMINATION OF URBAN SPRAWL CHARACTERISTICS
AND OF THE ROLE OF SOIL QUALITY
IN PERIPHERAL LAND USE CHANGES - GREATER VANCOUVER

by

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B.A., The University of British Columbia, 1973

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

in the

FACULTY OF GRADUATE STUDIES
Department of Soil Science

We accept this thesis as conforming to the
required standard

THE UNIVERSITY OF BRITISH COLUMBIA
October 1979

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ABSTRACT

This thesis examines some of the problems associated with urban sprawl, and attempts to determine the role of soil quality with respect to land use changes on four rural-urban fringe sites in the metropolitan Vancouver area.

Part I describes various characteristics of, and problems created by, urban sprawl, its effects on the countryside, and reasons why it occurs.

In Part II, the study sites are described in terms of soils, parent materials, drainage, and topography. In addition, physical and cultural information regarding the regions surrounding each site is given to portray each site in its larger context. Details and evaluation of the research results follow.

Four sites, one in each of the municipalities of Delta and Langley and two in the Municipality of Richmond, were selected with features reflecting the physical heterogeneity of the Lower Fraser Valley and for their proximity to urban centres. Four series of air photographs were assembled and examined, in conjunction with soils maps, to determine what land use modification had occurred over a period of about twenty years. Land use changes were correlated with soils data to determine which soils were most affected by urban development.
The results of this study appear to indicate that soil quality (for agriculture) by itself is insufficient to delay urbanization of fringe land. Other factors, such as isolation from urban centres, zoning provisions, and economic viability, are as important as soil quality in determining the fate of agricultural land on the rural-urban fringes of Greater Vancouver.
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ACKNOWLEDGEMENTS

The author is greatly indebted to her thesis supervisor, Dr. L.M. Lavkulich, for his encouragement, guidance, and patience throughout the course of this project; and to her committee members, Dr. C.A. Rowles, Dr. D.S. Lacate, Mr. G.G. Runka for their helpful advice and constructive criticisms.

Sincere thanks are extended to Mrs. Julia Lansiquot for the draughting of the figures, and to all the faculty, staff, and students of the Department of Soil Science for their friendship and encouragement during the course of this study.

To family and friends, special appreciation is tendered for their unfailing support and encouragement throughout the years of university study.
INTRODUCTION

In an historical context urbanization in western society has been in progress since the eighteenth century (Stone, 1969). At present it is a worldwide phenomenon, most noticeable in Third World countries. Canada, however, is not exempt from the trend. Indeed its rate of urban growth has been increasing since Confederation, with a slight pause occurring during the Depression followed by further growth from 1941 onward.

Of necessity urban growth requires land - land for housing, industry, commerce, transportation, educational and health institutions, and so on. Unfortunately it is often acquired at the expense of agricultural land at the city's periphery.

A significant portion of the rural-urban fringe areas of Metropolitan Vancouver, British Columbia contain soils which, according to the Canada Land Inventory classification system, are suitable for agricultural activities. In recent years urban encroachment onto these soils has hastened the removal of agricultural land from production and may have, in the process, significantly increased the reliance upon imports of previously home grown foods. The passage of the British Columbia Land Commission Act of 1973 was passed as a mechanism to control some of these land losses (BCLC, 1973).
This thesis proposes to examine the role of a particular characteristic of agricultural land, soil quality, and to determine its role in land use modification at the rural-urban fringe of Metropolitan Vancouver. It also proceeds from the null hypothesis that "the better quality soils have greater ability to forestall urban development".

Four sites, two in Richmond District Municipality, and one each in the District Municipalities of Delta and Langley, have been chosen for study. These particular areas were selected in order to represent the heterogeneous nature of the Lower Fraser Valley in terms of soils, parent materials, drainage, and topography. Because Richmond is more urbanized than are Delta and Langley one of its sites has been selected with some of the same soils characteristics as the other but without major subdivision. In addition, proximity to urban centres and the possible inherent restraints to urban growth possessed by each site have been considered. Hopefully the results of these studies can be applied to similar areas in the Lower Fraser Valley and elsewhere.

The concept of urban sprawl, the factors influencing its development, and its especial effects on the rural-urban interface will be dealt with in Part I. Examples occurring in the Canadian context will be accorded special emphasis.

Part II outlines the attempt to determine the changes in land use on each of the four sites over an approximate twenty year period, and mainly prior to the passage of the
British Columbia Land Commission Act of April, 1973. The modification of land engaged in soil dependent agricultural activities, such as small fruits and vegetables, grains and pasture, is of prime concern in this thesis. Accordingly, the interpretation of each site has been undertaken with these criteria in mind.

Analysis of data, the comparing and contrasting of land use changes of each area with respect to soil quality, plus the examination of the validity of the hypothesis, will comprise the summary.

It is believed that non-soil based activities have a valid place in this discussion. In accordance with this assumption, therefore, observations on the viability of non-soil based agricultural activities in the three municipalities will be included in the final remarks. Presentation of possible alternate land uses will be included as well.

British Columbia is poorly endowed with arable soils, soils which constitute a bare five percent of a total area of 100,000,000 hectares. In addition less that one percent is of prime Class One agricultural land (Huckvale, 1975). Losses of significant amounts of these soils to urban development will, in the writer's opinion, exacerbate the growing trend toward the importing of domestic food supplies. In should be realized that a number of our current foreign sources, such as California, are themselves the targets of the urbanization trend, and if they succumb to this influence the law of supply and demand will, in the future, ensure higher priced foods
from these areas.

We must also address ourselves to the moral issues involved, that is in an increasingly populating world we can no longer afford the luxury of haphazard and thoughtless urban growth when it involves the disposition of food-producing soils. Soils once paved are seldom recovered.
PART I. URBANIZATION AS IT AFFECTS RURAL LAND

A. INTRODUCTION

North American cities possess certain common structural elements (Broek and Webb, 1968). The oldest of these is the "central zone", often referred to as the central business district or downtown core which dates, in most cases, from the nineteenth century. It contains all manner of public and business enterprises plus residential enclaves, mainly for the rich or the very poor. Rail lines usually converge in this area.

In the late nineteenth and early twentieth centuries, and as the city expanded and the core's physical structures became obsolete or decayed, the "middle zone" emerged. Due to its diverse nature - light industrial, low income housing, commercial and so on - it has become the "grey area" in many cities and a major problem in urban reconstruction.

As the nineteenth century drew to a close the wealthy began to settle the "outer zone". Larger lots and substantial homes predominated. Parks, shopping areas and, in some cases, newer industrial plants were interspersed amongst the housing. The advent of mass transportation around World War One was instrumental in the complete utilization of this zone.

The fourth zone has been termed the "urban fringe" or the "cutting edge of suburbanization beyond the outer zone"
New housing subdivisions mingle with older villages, woodland and, frequently, farmland. It is this zone with which we are the most concerned.

The major part of the growth of cities takes place on this outer edge (Russwurm, 1976). Expansion often leads to inefficient and conflicting land uses accompanied by the loss, either by deliberation or because of ignorance, of good agricultural land. The term commonly employed for this phenomenon is "urban sprawl".

Other descriptive terms have been used for the components of expanding cities including suburban zone, commuting zone, urban fringe and urban shadow (Russwurm, 1976).

The suburban zone is one of continuous buildup of mainly newer houses which surrounds the older parts of the city. It is not a part of the urban fringe.

Commuting zone refers to the total area from which a city's workforce egresses, that is, approximately fifty to eighty kilometres from the built-up city limits and including the urban fringe and shadow zones. The latter two coincide, with the urban fringe adjoining the built-up city and the urban shadow occupying that land between the fringe and the outlying rural area.

According to Russwurm (1976) the urban fringe contains those elements which mark the intrusion of urban land use activities into the rural countryside, housing, industry, and commercial ventures among others. It may extend from
sixteen to thirty kilometres beyond the city limits. In his opinion the term "rural-urban fringe" is inaccurate as this zone "...is created by the outward expansion of the city" and that the word "rural" should be deleted. Nevertheless the term "rural-urban" - or "urban-rural" - fringe is commonly employed and for the purpose of this thesis will be synonymous with "urban fringe". It has also been described as an area of changing political, social and economic characteristics on a city's rural periphery (Crosswhite and Vaughn, 1962) or, more sardonically, as the "stockbroker belt" (Broek and Webb, 1968).

B. GENERAL CHARACTERISTICS AND PROBLEMS OF SPRAWL

The characteristics and problems peculiar to urbanization of outlying territories are many and diverse, encompassing both form and substance and varying in degree. Low densities, irregular land development, service deficiencies, social inconveniences, industrial and commercial land use problems and, especially relevant to this thesis, encroachment onto agricultural soils are the principal accoutrements of city spread.

1. **Low Density and Irregular Development**

All sprawl areas have one characteristic in common
low population density (Lower Mainland Regional Planning Board, 1956). The results of one survey conducted by the L.M.R.P.B. of British Columbia suggests a density of 8.75 persons per hectare whereas an eastern Canadian source suggests a range of twenty to fifty persons per square kilometre (Russwurm, 1976). These figures are not arbitrary. One must be cognizant of the geographical area under observation. What constitutes low density to a Hollander, for example, may be a crowded condition to an Arizonan. However, regardless of absolute numbers low population density can be said to be both a cause and an effect of poor land utilization.

Irregular or "ragged" development is a common feature of sprawl. Due to ever growing mobility of the average person in the world's industrialized nations - and especially in Canada and the United States - the outer fringes of the city are more accessible than ever before. Major traffic arteries become the lifelines of new or potential suburbs. It is along these roads that one becomes aware of the "ribbon" or "strip" type of development that often accompanies growth on the rural-urban fringe. A typical area might include a few small retail establishments, a gas station or two, fast-food outlets, a supermarket, a trailer court or motel, perhaps some scattered housing, and the ubiquitous used car lot.
"Leapfrogging" is another sprawl pattern and an extremely wasteful one (Clawson, 1972). It occurs when parcels of various sizes are bypassed in a hit and miss fashion, often the result of speculation. Clawson (1972) notes that even in areas classified as urban as much as thirty percent of the land may not be in urban use.

Low utilization frequently occurs in areas employing a grid system of survey. Lack of infilling accompanies growth on the periphery of the grid, a feature noticeable in many areas of the Lower Mainland of British Columbia, with typical examples being found in Richmond Municipality. The long narrow lots consequent of this type of development—somewhat reminiscent of the seignieural land holdings of early Quebec—habitually result in inadequate usage at the centre of the grid. These central areas may lie totally idle. Furthermore many property owners and their local governments are either unable or unwilling to remedy the situation or are indifferent to it. Thus sprawl is perpetuated.

As land becomes fragmented and densities remain low, various problems emerge.

2. Service Deficiencies

Unplanned growth predisposes a community to several unpleasant aspects of life including inadequate—or even no—sewer and water mains, gas, power and telephone lines, public
transportation, fire and police protection as well as decentralized educational facilities.

The efficient and orderly implementation of services requires compact, continuous urban development (Russwurm, 1976). Costs of sewer and water mains, fuel and power lines, and road systems are basically in proportion to their length, that is, the more persons served per unit of length plus the smaller the average frontage length per user the less costly the service will be. A British Columbia study has shown, for instance, that during the nineteen fifties the annual cost of water in sprawl areas of the Lower Mainland was twice as high as that of fully developed suburban areas (Russwurm, 1976). Similar examples have been documented elsewhere (Arch, 1972). It is apparent that if service costs are spread over an entire jurisdiction the fully developed portions will be subsidizing the uneconomic services of their less urbanized fellows.

Excessively low population densities may preclude certain services that city dwellers take for granted such as sewage treatment and adequate street lighting (Marks, 1952). Others may be present but be inconveniently located or sparse. It has been noted, for example, that in order to install a four-room school within one kilometre of every child, a small, ten-store shopping centre within one kilometre of each housewife, and a non-subsidized half house bus service within one-half kilometre of most homes the densities required would be two, three and five or more persons per hectare respectively, the
latter figure representing a low average density for a continuous single-family subdivision (Russwurm, 1976).

Inadequate police and fire protection are serious matters for obvious reasons. Property damage, through fire or vandalism, can be very severe if distances to be covered are too great or if water supplies are poor or unavailable. Problems may arise if the afflicted property lies beyond the boundaries of police and fire jurisdictions, and unless neighbouring municipalities have prior arrangements regarding emergencies property damage, as well as loss of life, could be catastrophic. Such losses could harm a community's financial position through diminution of tax revenue.

Fragmented land use affects not only the physical aspects of life but also the social ones.

3. Social Inconveniences

As noted previously provision of public transportation in suburban areas is dependent upon population density for economic feasibility. Lack of bus services tend to trap suburbanites, especially homemakers and the poor, unless alternate means of mobility are available. The purchase of a second car is often imperative. Such a purchase may place a heavy burden on a slim budget, perhaps already strained by housing and commuting costs.
Shopping facilities are often inconveniently located. A trip to the "corner store", maybe a kilometre or more away, is a major expedition for a mother with small children. Unless she possesses an automobile she must depend upon store delivery (somewhat scarce these days), public transportation if available, or her husband's good nature.

Recreational and cultural amenities tend also to be in short supply. Libraries, art galleries, parks, swimming pools, ice arenas, gymnasiums and so on are normally situated in areas of a high enough density to either defray their costs or to be as self-sufficient as possible. Scattered development permits neither condition. The fringe-dwelling family must ordinarily travel to an urbanized region in order to engage in activities city folk take for granted.

4. **Commercial and Industrial Land Use Problems**

Urban fringe areas are characterized by problems related to commercial and industrial enterprises. Manufacturing plants, construction activities, transportation terminals and airports are the most significant industrial land users on the rural-urban fringe (Russwurm, 1976). The fringe is deemed suitable for the latter two activities because of the need for cheap, abundant, level land and because of inherent noise generation, especially by railway marshalling yards and aircraft operations.
Manufacturing plants often require large acreages in order to engage in continuous single-level assembly operations, for example the automobile and aircraft industries.

Lesser industries, often odoriferous, smoky or dusty by nature, frequently dot the landscape along principal transportation routes from the city, thus enhancing the typical "ribbon" or "strip" configuration of sprawl. Some examples of industries in this category are concrete products, scrap metal yards, meat and poultry processors, wood products, sewage plants and garbage dumps. Russwurm (1976) points out that the incompatibility of land use activities rather than the need for large tracts of cheap land is the principal dilemma planners face with respect to the location of these industries. As yet it is unresolved. Industrial parks are a partial solution but only as long as urbanization of the surrounding area is held in abeyance.

Commercial development on the rural-urban fringe may take the form of a large shopping centre - such as Seven Oaks in Abbotsford or Guildford in Surrey - or individual businesses clustered in smaller shopping malls or strung out along highways. The first type requires large tracts of inexpensive land on or near a major access route. It may also locate at major intersections in order to draw in clientele from outside the immediate district. Subsequently it may attract residential development. The second type of commercial enterprise - motels, service stations, fast-food outlets - is
greatly dependent upon the transient element of trade. Consequently a highway location is vital to its existence. Not infrequently an unattractive appearance combined with traffic congestion are unwelcome accompaniments. Moreover this kind of business may face disruption if it is not included in future long-range development plans (Russwurm, 1976).

5. **Encroachment Onto Agricultural Land**

There are two major aspects to the problem of urban encroachment onto agricultural land: inefficiency of land use and unnecessary conversion of good farming soils to urban use (Russwurm, 1976). The inefficiency reveals itself as areas of idle land and as a plethora of small acreages, which may or may not be employed as "hobby farms" of whose value to society opinions differ (Pearson, 1972 and Rawson, 1973). Unnecessary conversion develops when urban growth bypasses marginal and submarginal land and impinges upon the top three soil classes for agriculture. Both conditions are affected by economic factors which will be discussed in the following section.

Contraction of high class farmland on the rural-urban interface has been documented in Canada for several years, including studies on the Lower Fraser Valley in British Columbia (Crerar, 1970), the Calgary-Edmonton Corridor in Alberta (St. John's Calgary Report, 1978) and the Niagara
Fruit Belt of southern Ontario (Krueger, 1970). In the latter case conversion of farmland has been a fairly continual process since the nineteen-thirties.

It has been suggested that the removal of land from food production has been exaggerated and that the real problem to be considered is the use of high rather than low quality land for urban purposes (Russwurm, 1976). Although more stringent planning regulations have, in various locations, slowed urban sprawl onto prime farming soils it remains a distressing problem (Calgary Report, 1978).

The characteristics of sprawl are physical manifestations of various economic, political and social influences. They will be detailed in the following section.

C. REASONS FOR URBAN ENCROACHMENT

1. **Mobility**

The daily journey to work was a common aspect of metropolitan life even in the early twentieth century (Broek and Webb, 1968). Distances travelled were usually not excessive and public transport such as trolley cars and trains were employed. Even employers lived near their businesses (Dyckman, 1970).
It was the advent of the relatively inexpensive, massed produced automobile, coupled with the development of extensive highway networks that, more than any other factor, was responsible for encouraging the sprawling outward growth of the modern city and the formation of its "bedroom" satellites (Barlowe, 1972). Thus the journey to work became "commuting".

The private car made it possible for those of modest financial means to experience the delights of the countryside during weekend outings. By doing so it also whetted appetites for less expensive housing on larger lots, far from inner city crowds and grime.

The preference for the automobile over public transportation modes is a very rational one (Lithwick, 1970). By improving accessibility its affords its user the benefits of job, market, and leisure commodities at a relatively low private cost. In absolute terms, however, the cost is high. Low income groups, unable to afford capital-intensive cars, lose their option to locate in suburban areas. They are forced onto high-cost land in the inner city. For them mobility contracts and confines itself to the use of public transportation services which, in many North American cities, have declined substantially as automobile usage has increased.

The car has a very high land-using capacity (Lithwick, 1970). The treadmill aspect of "more cars leading to more sprawl leading to more cars" is one of the most serious
components of urban life. With accompanying suburbanization the process accelerates as the need for more cars increases. Traffic congestion becomes an unpleasant by-product. In addition vast amounts of agricultural and other rural lands are consumed by necessary road building.

Studies undertaken by the Greater Vancouver Regional District (among others) serve to reveal how utilization of the private car has flourished on the Lower Mainland of British Columbia (Skoda, 1975). Between 1963 and 1972 road traffic in the rural-urban fringe grew by ninety to one hundred fifty percent in contrast to that of the urban core's thirty to seventy percent. The rural-urban fringe statistics reflect growth in the non-farm as well as suburban developments. At the time of the study optimism was expressed that the then current expansion of the public transit system would reduce the substantial differences in traffic growth between core and fringe areas.

This example has been repeated elsewhere in the western world and is a function of the comparatively free choice of residence and place of work enjoyed in our industrialized society (Dyckman, 1970). Desecration of the rural-urban fringe by way of sprawl is a self-inflicted condition brought about by the exercising of these freedoms. The private car is but a tool.
Mobility is one factor which influences urban encroachment of agricultural lands. Zoning, an important example of the use of "police power" to direct land use, is another.

2. **Zoning**

The concept of zoning is not a complicated one. Essentially it means the division of land into districts having different regulations (Barlowe, 1972). It is an implement rather than a substitute for land use planning, its effectiveness being a function of the character of the planning upon which it is based. It is one of the traditional methods of growth control (Levine, 1974). Zoning regulations pertaining to urban residential communities, for example, have historically been adopted as means to ensure - among other things - a decent quality of life. Control of undesirable environmental influences such as factories, skyscrapers, noise-producing concerns, fire hazards and so on, is an essential element of zoning in urban areas. Rural zoning tends to be more concerned with the determination of lands on which agriculture, forestry and recreation are to be conducted (Barlowe, 1972).

It is unfortunate that zoning, relied upon to introduce orderliness to the land planning process, has frequently been weakened by the ad hoc manner in which it is
often applied, especially without regard to a long range master plan, indeed if any exists (Clawson, 1972). In other words zoning is only as strong as the individuals and organizations employing it and sprawl proliferates where effective zoning is absent (L.M.R.P.B., 1956). Problems arise when planning agencies become powerless, through inherent lack of co-ordinated effort, to control possible capacity and vested interests of private firms and individuals who, Clawson (1972) states, have exerted the determining influence on the form of American suburban development. Canada has not been immune to such activities either. Rural-urban fringe lands are frequently in jeopardy, partly because of demographic composition. For instance farmers, nearing retirement age and in many cases unable to make their businesses economically viable for one reason or another, are approached by developers with monetary offers sufficient to permit retiring in comfort. They seek relief in rezoning. Often exceptions are made and thus the urbanizing influence spreads. This has been the history of zoning in North America (Franson, 1972). Private individuals, daunted by the high cost if city housing lots, look to the cheaper farmland on the urban periphery - as much for a lifestyle as for an investment. These people frequently become "hobby farmers", opinions of whose value to society range from mild enthusiasm (Rawson, 1973) to outright distaste (Calgary Report,
1978). One could concede these holdings as having some redeeming social value and that adequate husbandry might, for a time at least, help keep urban sprawl in abeyance. On the other hand such "farms" can become the catalysts for rezoning and subdivision. Legitimate farmers are frozen out by greatly increased land prices which make farming economically unsound. If cities themselves are located on Soil Classes One, Two and Three the problem of fringe agricultural land loss becomes even more acute.

Two Canadian cities, Edmonton and Calgary, are affected by the aforementioned situation. The former is located on Class One soil and the latter is on Classes One and Two soils. Each has taken a different approach to fringe land retention. Edmonton's regional planners believe that if a parcel of land remains large enough - at least thirty-two hectares - the owner will either farm it himself or rent it out to another farmer. In this way the top three soil classes will be saved. Calgary planners, conversely, have attempted to thwart potential developers and to slow the reclassification of agricultural land by maintaining lot sizes of 0.4 to 0.8 hectares rather than the eight to sixteen hectares the developers and hobby farmers have been buying. It remains to be seen which approach will be the most successful.

It is unfortunate that zoning is often viewed as a defensive mechanism to prevent undesired development rather than as a positive approach to better land use planning.
The rural-urban fringe by its very nature is in particular need of co-ordinated, comprehensive long range planning by all levels of government. Difficulties arise when government agencies are at variance with one another regarding public policy.

One area of policy and legislation which has had considerable impact on fringe areas is that of taxation.

3. **Taxation**

The primary purpose of taxation is to raise revenue (Rawson, 1961) and two particular types of taxes affect land resources.

The first is the general property tax, that is a charge - usually annual - against the assessed value of non-exempt properties within a taxing district (Barlowe, 1972).

The second kind is the special assessment, used to finance the construction of roads, sidewalks, sewers and other improvements. Special assessments have the power of raising or lowering property values, for example the upgrading of a residential road to a main thoroughfare resulting in a lowering of house values to the homeowners (Barlowe, 1972).

The general property tax appears to be the most influential tax affecting urban encroachment onto fringe lands. As a revenue base it is highly inelastic with respect to urban development, a factor which leads to fringe land being
underassessed, its market value lowered and its vulnerability to sprawl enhanced (Lithwick, 1970).

Agricultural property has traditionally been assessed at lower rates than its city counterpart. When it is part of the rural-urban fringe, however, farmland with potential subdivision value can often be pressured into higher use if assessed at current market value rather than just for agricultural purposes (Calgary Report, 1979). Although only a small proportion of the total land area may be high priced it may affect the pattern of land prices and tax-assessed values for the entire area. Furthermore land is often required, though zoning restrictions, to be valued at its highest and best use regardless of present use (Nader, 1973). The increased taxes which usually follow may be sufficient to force a diminution, if not a complete suspension, of farming activities. As noted previously a lack of economic viability may encourage farmers to sell out to developers or hobby farmers.

On the other hand hobby farmers may themselves become victims of increased assessments and soaring taxes. For example, in 1978 small landowners near Edmonton, Alberta were confronted with assessment increases that would have, in some instances, raised taxes up to five thousand percent. Their appeal to the provincial assessment appeal board for relief on the grounds that, although they occupied less than eight hectares, they should still be taxes as farmers was
It has been noted that land taxes, contrary to the theory behind them, seldom reflect the current productivities of land resources (Timmons and Cormack, 1971), and over the years they have often been employed to either promote or discourage particular economic activities. In some Latin American countries penalty taxes have been adopted to discourage under-utilization of land. In particular, Colombia enacted a law in 1957 wherein all rural land were officially classified, a specific minimum proportion of which had to be cultivated. In addition an annual penalty tax was to be exacted from holdings which failed to meet production quotas (Barlowe, 1972). Potential losses of fringe agricultural land might be curtailed if, as Timmons and Cormack suggest, land taxes for revenue purposes were eliminated and were used "solely as a means of discouraging or encouraging the use of land resources in an acceptable manner". At present this does not appear to be happening.

Although the impact of taxation is significant, it has been suggested that fringe areas are even more adversely affected by land speculation (Pickard, 1966).

4. Speculation

Land speculation refers to the holding of land over time with the expectation of it increasing in value without
any improvements being made (Russwurm, 1976).

Speculative activities tend to thrive during periods of inflation since under more stable conditions investors may have to retain property for several years before being able to sell at a profit (Barlowe, 1972). Using land as an inflationary hedge carries a caveat, however, as successful speculation requires land values to appreciate more rapidly than fixed holding costs such as taxes. At present - in Canada at least - land brokers are optimistic regarding property on the urban periphery. They expect fringe land purchases to double in value in less than ten years and to give at least a ten percent annual return (Russwurm, 1976). Higher prices also occur as land changes hands, perhaps several times, with the additional costs being passed on to the consumer.

Russwurm (1976) makes reference to a number of problems incurred by speculation, the first of which is the unnecessary escalation of land values, due mainly to the factors noted above.

Secondly, unnecessarily large areas may remain idle due to land being held in expectation of future profit. Such was the case regarding land designated for Mirabel Airport, about seventy-two kilometres north of Montreal. A vast area of about nineteen hundred fifty kilometres square was declared a special planning area and development was frozen. Farmers' expectations rose, land values soared and speculation was rife
Under these circumstances soil conditions may deteriorate to such a degree as to render it unfit for agricultural purposes without substantial capital outlay. In addition rising prices tend to make the land economically viable only for urban uses.

Speculation also leads to planning problems. Orderly and continuous development is rendered difficult when large tracts of land are held off the market in anticipation of future monetary gain. As well speculators may disagree with planners over development of their property and, if influential enough, may persuade governing bodies to undertake projects which are in conflict with planning recommendations.

Sprawl is almost totally the end product of land speculation (Rawson, 1961) and if it is to be curbed social attitudes must be examined and hopefully modified.

5. Public Attitudes

It is doubtful that ad hoc development of the rural-urban fringe would have taken place - at least to the extent it has - if the prevailing attitude toward it was negative. Tolerance of piecemeal land use stems primarily from the economic philosophy of laissez faire, more specifically the right to do with one's property as one sees fit and to turn a profit as well, regardless of the consequences to society
as a whole. Adam Smith, in his treatise "Wealth of Nations", expressed it thus:

"Every individual endeavours to employ his capital so that its produce may be of greatest value. He generally neither intends to promote the public interest, nor knows how much he is promoting it. He intends only his own security, only his own gain."

(Samuelson and Scott, 1968)

North Americans in particular are strong adherents of this philosophy.

In Western-style democracies the sale of land for the purpose of realizing a profit is considered an inherent right and any moves to confiscate all or a portion of such a gain might be strongly resisted. In an interview regarding land speculation problems with the then Canadian environment minister, Jean Marchand, a newspaper reporter elicited the comments that "...the philosophy of profit is something which is part of our society..." and that "...Canadians believe, rightly or wrongly, that private enterprise is the best way of achieving the common good" (Rotering, 1976). These statements would probably be echoed by most of his political counterparts in America.

The issue of what constitutes fair profit on land sales is a very complex one. It was suggested in a report
released by the Canadian Habitat Secretariat (1976) that a major portion of unearned increment should be confiscated or taxes away or, in the words of the then Minister of Justice, Ron Basford, "The unearned increment resulting from the rise in land values resulting from change of use of land, from public investment or decision, or due to the general growth of the community, must be subject to appropriate recapture..." (The Province, 1976). It was uncertain at the time whether "appropriate recapture" represented as much as one hundred percent taxation or only the confiscation of a very small portion. Although the prospects of recapture may appeal to persons of the Third World or elsewhere, most North Americans would deem it quite unacceptable.

When land was deemed plentiful the emphasis on individual rights was an expression of social needs at the time. However it appears that collective rights have assumed a greater importance with respect to the division of property. Effective land use planning necessitates a balance between public and private interests.

A major obstacle to the restructuring of rights in land between the individual and the group is the value system of the public at large (Castle and Rettig, 1972). One's concept of what constitutes private property, as well as the proper role of local authority, may be at variance with solutions to problems initiated by society as a whole. Castle and Rettig (1972) believe that more extensive planning may
bring about greater recognition of the basic problem, that is, private versus collective needs. It will be necessary, they point out, to find other means to satisfy such opportunities for individual self-expression as are traditionally found through the development of private property, entrepreneurship and decentralized decision-making. If the situation is ignored they foresee the occurrence of inadequate measures to cope with fundamental land use problems such as loss of farmland on the rural-urban fringe.

With respect to peripheral agricultural the major problem has been the lack of respect for agricultural land as a valuable non-renewable resource (Parker, 1968). The bona fide farmer usually regards the land as a trust, to be carefully husbanded and passed in good order to future generations. On the other hand urban dwellers tend to look upon it as a commodity, one to be subdivided, sold and built upon. Parker (1968) views these conflicting value systems as holding grave implications for land areas that are clearly suitable for agricultural activities. This concern can also be applied to fringe areas elsewhere in Canada, for example the Niagara Fruit Belt, the St. Lawrence Lowlands near Montreal, and the lacustrine soils of the Red and Assiniboine river systems near Winnipeg (Crerar, 1970). The San Joaquin and Imperial valleys in California are two of the outstanding American examples of fertile areas threatened by conflicting rural and urban attitudes toward land development.
In addition the notion that the sum of individual actions can be collectively costly is incomprehensible to many (Benson, 1972). Thus the urbanizing of small scattered properties on agricultural land is expensive in terms of the depletion of a fragile, finite and basic resource as well as in the money wasted on inefficiently organized services.

Land use conflicts are as old as civilization, yet it is relatively recently that they have become such important topics for discussion. Previously land was considered to be a relatively abundant resource. Lately, however, population growth and the increasing demand for and of the land has served to emphasize its inherent inelasticity. This irreplaceable commodity is being called upon to feed, clothe, shelter, transport, employ, and to provide recreational amenities for more human beings than ever before. In doing so it is undergoing substantial changes, the dynamics of which are becoming the foci of attention at all levels of government.

6. Government Policy

It would not be unfair to say that government policy, or lack of it, has been a contributing factor in the erosion of peripheral farmland. In essence the structural complexity of government has served to create distortions and weaknesses in land use planning, thereby encouraging ad hoc development on the rural-urban fringe.
Primary responsibility for urban sprawl usually rests (in Canada) with the local government, that is to say with villages, towns, cities and municipal districts within a province. A particular weakness at this level is the multiplicity of governmental units which result in the fragmentation of services to the public (Del Guidice and Zacks, 1968). Furthermore the excessive bureaucracy tends to produce insufficient co-ordination in the establishment of sound land use objectives, not to mention less public control and awareness of planning problems.

As well as permitting inefficiencies overlapping jurisdictions contribute to contradictory policy-making (Benson, 1972). This is evident where, for example, one government agency grants tax concessions to a resource industry which contradict the efforts by another agency to encourage conservation of the same resource.

Local community plans are frequently at variance with regional views on factors influencing local growth as well as ignoring the possible effects on peripheral agricultural land where it exists (Robinson, 1970). Indeed local policies, or an absence of them, can seriously impair or nullify farmland conservation efforts of other levels of government. At the same time senior governments are not always cognizant of the effects of their own policies. In the early nineteen seventies the British Columbia government established the Greenbelt Fund for the purchase and preservation of land for farming
and recreation. Some of this land was in the predominantly agricultural municipality of Delta, near the City of Vancouver. Government purchase prices for farmland ranged from $10,000 to $12,500 per hectare. For agricultural purposes, however, it was valued at only $3,750 per hectare. It was suggested that sales for farming activities would dry up since farmers would not wish to pay the higher prices and that land owners would be unwilling to sell for less than the government was prepared to pay. In effect the agricultural land market would be stifled and rather than preserving farmland government policy would be encouraging the opposite result (Pearson, 1972).

Conversely senior governments may carry out policies which are at odds with local community goals. One example is that of the United States government highway construction programme which has contributed significantly to urban sprawl in that country (Blumenfeld, 1966).

Equally as important as government policy per se is the quality and quantity of citizens' contributions to the planning process. Public hearings have been more frequent occurrences in the few years, although some people view them as waste of time (Franson, 1972). Nevertheless they are also regarded as necessary adjuncts to the planning process and for the attainment of consensus regarding planning decisions.

Whether governments truly value public opinion, however, is another matter entirely and at times the courts may be called upon to force government planning agencies to consider public opinion regarding proposed land use changes.
Early in 1979, in a thirty-seven page judgment, the Alberta Appeal Court ruled that the Calgary Regional Planning Commission (C.R.P.C.) and the Rocky View Municipal District Planning Board must grant a new hearing to a fringe area rancher regarding an illegal quarter-section subdivision adjacent to his land. The rancher had earlier objected to the development of the subdivision on the grounds that it was "an intrusion of a residential community into an extensive cattle ranching operation". The C.R.P.C. and the provincial planning board had agreed. However, as the law permitted him, the developer continued to pressure these agencies for approval, with the provincial planning board eventually agreeing to let the three home subdivision remain. The rancher appealed. In its judgment the Appeal Court ruled that although the developer's considerable expenditure "was made in good faith, this is not a matter relevant to good planning" and that it is incumbent upon planning agencies to consider the public interest in the "orderly and economic development of the area". This legal judgment was prompted by the decision of the Municipal District of Rocky View to reclassify this particular area from agricultural to rural small holding without any consultation with the rancher affected or anyone else concerned (Schmidt, 1979). Further investigation would probably uncover many similar incidents in Canada and the United States.
The world and society are evolving constantly and although the aforementioned contributors to urban encroachment onto farmland - mobility, zoning, taxation, speculation, public attitudes and government policy - are deemed by the writer to be paramount, one could probably cite others equally as valid.
PART II. THE RESEARCH SITES

A. INTRODUCTION

The four sites involved in this study were selected in order to represent a cross-section of the Lower Fraser Valley in terms of soils, parent materials, drainage and topography. In addition, such factors as proximity to urban centres and possible inherent restraints to urbanization of each site have been considered. A general description of the municipalities in which these areas are located has been included to reveal each site in its larger context.

The first two sites are located in Richmond Municipality. Although each has some soil characteristics in common with the other, one has been exposed to subdivision development whereas the other has not. Paradoxically, it is the site farthest from the major urban centre of the area - Vancouver - and possessing the poorest engineering soil qualities in which development has occurred.

Site number three is located in the uplands of Langley Municipality. The closest urban centre is Langley City, about three kilometres to the northwest.

The last research area is a portion of Westham Island in the Municipality of Delta. The island is at the mouth of the Fraser River and represents an outstanding example of deltaic landscape. Besides its physical characteristics the relative isolation from large urban centres was a factor
in its selection for study.

Research was undertaken primarily by employing air photographs and land use maps. Photos were examined to determine the presence and extent of obvious urbanization, including subdivision development, and the presence and extent of improved acreage, that is the conversion of forest to agriculture and/or forest to urban use. The results were correlated with soil data to determine what soils were subject to adverse modifications with respect to agriculture.

Richmond, Langley and Delta municipalities form part of the Fraser Lowland, that part of the Coastal Through which lies within the Georgia Depression. This area, ranging from near sea level to about one hundred twenty metres above sea level is characterized by wide, flat-bottomed valleys and extensive areas of rolling uplands. Drainage is provided by the Fraser River. Most of the area is underlain by granitic bedrock covered with deep surficial deposits, formed during the Recent glacial age which terminated about ten thousand years ago. The delta is still in the process of formation (Acron and Crosson, 1978).

Agriculture is the main land use in the Fraser Lowland. Mild climatic conditions permit a wide range of crops, regional suitability of the same being determined by soil variations. Wetland Organic and Gleysolic soils are well suited to the production of crops such as broccoli, cabbage, carrots, corn, lettuce, onions and potatoes. Small
fruits - blueberries, cranberries, raspberries and strawberries - are concentrated within adaptable soil areas.

Other soil and non-soil based agricultural activities include poultry raising and the large, long-established dairy industry, mink ranching, horticulture, equine breeding and domestic pet boarding.

Water management problems are the principal ones confronting agriculture in the Lower Fraser Valley (Acron and Crosson, 1978). The need for artificial drainage is precipitated by high winter water tables whereas summer moisture deficits must be overcome by irrigation.

The Fraser Lowland is, by most peoples' standards, a fine place to live, work, and play. Because areal population and its attendant development is increasing, land use conflicts are becoming more evident. Agriculture must compete with other land uses for space in a finite region.

B. SITE INFORMATION -- RICHMOND, B.C.

1. Geography and Land Use

The Township of Richmond, also known as Richmond Municipality, is situated at the mouth of the Fraser River and at the extreme western end of the Lower Fraser Valley of British Columbia. It is bounded on the north by the City of Vancouver from which it is separated by the north arm of the
Fraser River; on the west by the Strait of Georgia; on the south by the Municipality of Delta from which it is separated by the south arm of the Fraser River; and on the east by the Queensborough district of the City of New Westminster.

Richmond is composed of several islands, the principal ones being Lulu Island (10,033 hectares), Sea Island (1,528 hectares) and Mitchell Island (105 hectares). The rest are smaller islands of various sizes (Foarstel, 1964).

Lulu Island is the site if a variety of land uses including residential, agricultural, industrial and commercial. Access to Vancouver is made possible by the Knight Street and Oak Street bridges. The George Massey (Deas Island) Tunnel connects the island to Delta via Highway 499.

In contrast, Sea Island is dominated by the aviation industry, its presence manifested by airplane hangers, airline offices and the Vancouver International Airport. Little agriculture remains and residential development is limited mainly to two small subdivisions, one located in the south-eastern corner of the island and the other about two kilometres north of the airport terminal. Direct access to Vancouver is limited to the use of the Arthur Laing Bridge, constructed to facilitate the flow of airport traffic. Three minor bridges span the middle arm of the Fraser River.

Mitchell Island's land use is limited mainly to industrial and commercial enterprises. Residential development is insignificant. Direct access to Vancouver and Lulu Island
occurs via the Knight Street Bridge.

At present about 3,600 hectares are actively used for agricultural production in Richmond (Greater Vancouver Regional District, 1975) including small fruits (strawberries, raspberries, blueberries and cranberries, the latter two being grown on organic deposits in eastern Richmond), poultry, vegetables, horticulture, grains and dairy cattle.

2. Geology

Richmond is part of the Fraser Valley Delta, an area extending from the Strait of Georgia eastward one hundred and twenty-eight kilometres, and from the Canada - United States border northward to the Coast Mountains. The delta, still in the formative process, lies mainly below the level of extreme high tide and is extensively dyked to prevent flooding. Alluvial sands, fifteen or more metres deep, are underlain by a fairly thick clay and silty clay section, with a total deposition of as much as two hundred and thirteen metres being found on Lulu Island (Armstrong, 1956). Large sphagnum peat bogs are found on the eastern side of the island.

In common with areas of similar geology, Richmond experiences difficulties with surface runoff, the clay and silty clay soils being largely impervious to downward percolation. The peat bogs are sources of engineering problems as loading produces excessive compaction and poor
drainage. Substantial fill must be utilized in foundation and road construction.

The high water table adversely affects septic tank sewage disposal since the successful operation of a unit is dependent upon the maintenance of water levels below the absorption tiles (Armstrong, 1956). Proper water levels are maintained by numerous dykes and pumping stations. Although serious flooding has not taken place since 1948 the inherent nature of the Fraser River presupposes a similar occurrence in the future.

3. Community Development

In 1862 settlement of Richmond began and its incorporation as a Township followed in 1879 (Richmond Review, 1976). The salmon industry became firmly established — largely by the Japanese — in the southwestern Lulu Island community of Steveston (Siemens, 1968). Of special importance during the years preceding 1909 were the dairy industries of Lulu and Sea islands, sources of Vancouver's milk supply (Winter, 1968). In addition the fertile delta soils yielded farm products such as potatoes, hay and oats (Roy, 1968).

The years prior to World War I were spent in establishing communication and transport networks between the young township and its neighbours. The Canadian Pacific Railway, desirous of serving the canning industry, established the
Vancouver and Lulu Island Line in 1905 (Roy, 1968), with the British Columbia Electric Railway assuming its operation around 1914 in recognition of the area's agricultural prospects. Road networks were laid out in the grid system, the pre-1905 structures consisting of "corduroy" and planking (Meyer, 1968). Pursuant to the primary purpose of linking the settlers to their market centres, local street patterns evolved around rail connections to Vancouver and New Westminster.

After World War I, and as motor transport reduced dependence upon the railways, B.C. Electric Railway - now B.C. Hydro Railway - became a freight feeder line for local products destined for the transcontinental railways (Roy, 1968). At present Richmond is served by the Canadian Pacific and Canadian National railways, plus the B.C. Hydro Railway with connections to the Burlington Northern Railway and the United States. For motor transport the Fraser-Delta Throughway bisects the township providing rapid and convenient access to the United States via Highway 499.

In the meantime the population had increased steadily. After World War II the substantial rise in automobile usage encouraged new residential development. Settlement occurred near main roads, thereby reducing travel time to employment in Vancouver. Steveston, the original urban centre, had attracted residential growth to the west of Number Five Road (Foerstel, 1964). During 1950's residential growth proceeded very rapidly, its progress facilitated by the opening of the

4. Restraints on Development

Richmond is an attractive place to live and work. However three environmental factors have been cited as limits to future urbanization on any land other than that now designated. They are agricultural preservation, flooding danger, and airport noise (G.V.R.D., 1975).

At present about 3,600 hectares are in agricultural production with more than fifty percent of the farm lying on Canada Land Inventory Classes One and Two soils. Primary and secondary agricultural land reserves have been instituted in order to protect the farmland and have, in the process, created clearly defined southern and eastern boundaries for urban development.

The township lies wholly in a floodplain, thus establishing another limit to growth. Present policy restricts urbanization to its present boundaries. With exceptions of Steveston and Bridgeport no development can take place east of Number Five Road or south of Steveston Highway. This policy affords further protection to farmland as the agricultural reserves also lie in the floodplain.
Airport noise is a less obvious problem out nevertheless an important one. High noise levels are being experienced by the Sea Island subdivisions plus areas north of Westminster Highway and east to Number Seven Road on Lulu Road. Lesser levels are encountered elsewhere. The amount of disturbance is a function of operational procedures and runway configurations. Barring a severe enough energy crisis to bring about a noticeable diminution of air travel, high noise levels are expected to continue into the foreseeable future.

5. **Site Information - North Site**

a. Area - 2.6 square kilometres bounded by Cambie Road on the north, Number Seven Road on the east, Westminster Highway on the south, and Number Six Road on the west.

b. Topography - mainly gently undulating to undulating with slope values ranging from 0.5 - 5 percent.

c. Soils -

   (i) Annis Rego Gleysol (peaty phase)

   - Parent Materials: organic over alluvium
   - Drainage: poor to very poor
   - Agricultural Capability: can support small fruits such as blueberries and cranberries, and forage crops.
- Limitations: poor drainage. Artificial drainage is a must for all crops but cranberries and blueberries. Improvement of aeration, rooting depth and permeability needed by way of occasional subsoiling.

(ii) Blundell Saline Rego Gleysol (peaty phase)
- Parent Material: organic over alluvium
- Drainage: poor to very poor
- Agricultural Capability: can support forage production, oats, potatoes and canning peas.
- Limitations: poor drainage. Tiles and ditches are required for water table control.

(iii) Delta Saline Orthic Humic Gleysol
- Parent Material: alluvium
- Drainage: poor
- Agricultural Capability: can support a wide variety of crops including potatoes, canning peas, sugar beet seed, strawberries, cereal grains, forages, silage and sweet corn.
- Limitations: poor drainage and susceptibility to puddling. Soil should not be cultivated when wet. Artificial drainage is required for winter water table
control in order to facilitate spring planting and cultivation.

(iv) Kitter Orthic Gleysol
- Parent Material: alluvium
- Drainage: moderately poor
- Agricultural Capability: good for a variety of crops including forages, oats, strawberries, potatoes, and vegetables such as canning peas and beans.
- Limitations: the accumulative effects of several minor soil characteristics including restricted drainage and rooting depth, plus slight topographical restrictions. These produce uneven maturation of such crops as beans and canning peas.

d. Restraints on Urbanization - this site lies on a floodplain and, as noted previously, policy has dictated that this area (east of Number Five Road) be restricted from urban development. In addition, it is within the boundaries of the agricultural land reserve.
6. Site Information - South Site

a. Area - 2.6 square kilometres bounded by Granville Avenue on the north, Number 5 Road on the east, Francis Road (equivalent) on the south, and Number 4 Road on the west.

b. Topography - almost level to gently undulating with slope values ranging from 0-2 percent.

c. Soils -

   (i) Blundell Saline Rego Gleysol - see north site information

   (ii) Lumbum Typic Mesisol (fibric type)
       - Parent Material: organic
       - Drainage: very poor
       - Agricultural Capability: can support blueberries, cranberries, some forages, plus truck crops such as lettuce and carrots if proper water table control is present.
       - Limitations: the very poor drainage. Improved drainage would improve the capability rating.

   (iii) Richmond Terric Humisol
       - Parent Material: organic over alluvium
       - Drainage: very poor
- Agricultural Capability: can support blueberries, cranberries, forage crops, and vegetable crops such as carrots, lettuce and potatoes.

- Limitations: poor drainage. Sufficient water table control would be required before soil could be extensively used for anything but blueberries and cranberries. This soil is difficult to re-wet once completely dried.

(iv) Triggs Sphagno-Fibrisol
- Parent Material: organic - mainly sphagnum with some hypnum mosses.
- Drainage: very poor
- Agricultural Capability: very low; blueberries, cranberries, forages and perhaps some truck crops.
- Limitations: very poor drainage and low fertility. Reclamation by way of high water table control would be required before this soil could be fully utilized for agriculture. In addition this soil is difficult to re-wet once dried out.

d. The site lies on a floodplain, its soils have poor engineering capability, and it is within the boundaries of the agricultural land reserve.
C. SITE INFORMATION — LANGLEY, B.C.

1. Geography and Land Use

The Municipality of Langley, about 312 square kilometres in size, is situated at the approximate centre of the Fraser Valley delta. Its boundaries are the Fraser River to the north, 276th Street on the east, the Canada-United States border to the south, and 196th Street on the west. The immediate neighbours include the municipalities of Surrey, Maple Ridge and Matsqui on the west, north and east respectively and Washington State on the south. Two small islands Brae and McMillan, lie offshore in Russell Reach, north of Fort Langley, and are separated from the main body of the municipality by Bedford Channel.

Land use in Langley is varied but the major portion of the municipality is rural, with the land mainly engaged as cropland, improved and unimproved pasture, grassland and forest (Skoda, 1975). Dairy cattle, poultry, horse breeding and domestic pet boarding comprise some examples of other agricultural activities. Commerce, industry and housing are located in three principal areas: Langley City, near the Surrey border; the town of Fort Langley on the Fraser River; and the town of Aldergrove, near Matsqui. Zoning — for subdivision control purposes — ranges from roughly 0.2-8 hectare parcel limits, with dog kennels being permitted in
some areas zoned two or more hectares. McMillan Island is the site of an Indian reservation.

Direct access between Langley and other Lower Mainland areas and the United States is available through the use of Highway 401 (Trans-Canada) and the north-south Aldergrove – Sumas Highway. Access to the north shore of the Fraser River from Fort Langley is provided by the Albion Ferry.

2. Geology

Langley represents several geological facets of the Fraser Valley Delta (Central Fraser Valley Regional District, 1972).

The lowlands, ranging from zero to twenty-one metres above sea level, are composed mainly of silty and clayey floodplain and deltaic deposits of the Campbell, Fraser, Nicomekl and Salmon rivers. Topography ranges from flat to undulating with large portions having poor drainage, especially during winter months. In summer irrigation is required for the Gleysols and light-textured Regosols. The lowlands are classed as fertile with respect to management requirements.

The uplands, ranging from twenty-one to about one hundred twenty-two metres above sea level, are considered less fertile and less well adapted to general farming. These
areas appeal mainly to orchardists, cattlemen, mixed farmers, hobby farmers and the retired. In general farms are smaller than those of the lowlands due to difficulty in removing heavy tree cover. Parent materials are largely glaciomarine and outwash deposits of medium texture. They are moderate to well drained. Topography varies from undulating to rolling and is interspersed with flat terraces.

Small amounts of organic soils are also present in the forms of peat and muck, the latter being the more fertile and, as such, suitable for intensive truck farming.

It has been estimated that the municipality has 2,032 hectares of Classes One and Two soils, 24,380 hectares of Classes Three and Four, 3,348 hectares of Class Five, 2,929 hectares of Classes Six and Seven, and 972 hectares of organic soils (C.F.V.R.D., 1972).

3. Community Development

The modern history of Langley begins with the founding of Fort Langley in 1827 by the Hudson's Bay Company, hereafter referred to as "the Company" (Howell-Jones, 1968). This settlement, the first European one in the region, engaged in the collection and export of furs and salmon, agriculture assuming later importance as farming developed to supply the Company and Russian Alaskan forts. Due to its active discouragement by the Company, independent settlement did not
begin until 1858, the year in which the new crown colony of British Columbia was formed. Fort Langley became its first capital. Later, in 1873, the present Municipality of Langley was incorporated.

Meanwhile, road and water links from the fort to its customers were established. Trails cut through the dense forest, sometimes following Indian trails which were located on higher ground. The Fraser River system (and particularly the Nicomekl and Salmon rivers) was utilized as much as possible (Meyer, 1968).

The 1858 Gold Rush hastened agricultural settlement of the Fraser Valley, settlement designed to provide food for the miners. Later, however, customers elsewhere were sought and more efficient transportation was needed in order to supply them. Railways were to assume a new importance (Roy, 1968).

The governors of the Canadian Pacific Railway had, by 1878, determined that a route through British Columbia to tidewater on the Pacific Coast should be established. Exhibiting corporate attitudes worthy of those of the present day, the route was selected to satisfy the Company's desire for economy and future profits rather than to cater to the needs and resources of the Valley. The ensuing line completely bypassed the south side of the Fraser River, much to the chagrin of its residents. It was left to an English company to satisfy local needs.
The British Columbia Electric Railway inaugurated services to New Westminster, Langley and Chilliwack in 1910, an association which was to last for forty years. The line, closely paralleled by that of the Canadian Northern (later Canadian National) Railway, soon displayed its river steamer competitors and had a favourable impact upon the Valley’s farming and lumber economies.

As new roads were built and existing ones upgraded motor transport eventually displaced most rail services. In 1923 the B.C.E.R. initiated its own bus service, Pacific Stage (now Pacific Coach) Lines, in recognition of the trend. The railway now exists as a feeder line.

Because Langley was considered a substantial distance away from the principal centres of urban growth, it maintained almost total rurality and a relatively slow population growth until the 1960's. The completion of Highway 401 made accessibility easier for those workers employed in Vancouver, Burnaby and New Westminster who favoured a rural lifestyle. The 1976 census gave the municipality's population as 35,926.

4. Restraints on Development

Langley is a pleasant, rurally oriented community now facing external pressures for increased urban development. However certain characteristics make excessive growth inadvisable.
First of all, its low lying areas are flood-prone, although dyking is present.

Secondly, fair or poor drainage, the bane of agricultural production, adversely affects much of the municipality, especially the lowland areas. Upland runoff, frequently created by land clearing, strains stream and ditch capacities at lower levels. Flat areas, and those covered by relatively impermeable marine sediments, are subject to ponding and saturation (Luttmerding and Sprout, 1966).

Thirdly, the forest covering much of the upland areas is expensive to remove. As stated earlier improper clearing may lead to excessive runoff and, equally serious as far as agriculture is concerned, topsoil removal.

Fourthly, most of Langley has a limited supply of ground-water for irrigation purposes and domestic water, principally supplied by artesian wells, is difficult to tap from areas underlain by glaciomarine sediments (Luttmerding and Sprout, 1966). In low precipitation years water shortages could occur if urban development increases enough to adversely affect the withdrawal-recharge flow of the aquifers.

Fifthly, the area lies within the agricultural land reserve and cannot undergo land use changes without special dispensation.

Finally, the residents appear to favour an essentially
rural atmosphere. Accordingly, the municipal by-law for subdivision control reflects this attitude.

5. **Site Information**

a. Area - 3.9 square kilometres bounded by 28th Avenue (equivalent) on the north, 224th Street on the east, 16th Avenue on the south, and 216th Street on the west.

b. Topography - widely varied, ranging from virtually level to very steeply sloping. Average topography is undulating to gently rolling. Slope values range from about 0.5-30+ percent.

c. Soils -

   (i) Albion Humic Luvic Gleysol
       - Parent Material: glaciomarine
       - Drainage: moderately poor
       - Agricultural Capability: hay and pasture. Some areas are heavily wooded. This soil was originally part of the Scat series but has been separated because less severely restricted drainage.
       - Limitations: mainly drainage. This soil is subject to saturation and some flooding during periods of heavy rainfall.
(ii) Heron Rego Humic Gleysol
- Parent Material: marine
- Drainage: poor
- Agricultural Capability: can produce hay and pasture
- Limitations: poor drainage. Heavy forest clearing (where applicable) plus drainage system installations required for reclamation.

(iii) Judson Terric Humisol (muck)
- Parent Material: organic over glaciomarine
- Drainage: very poor
- Agricultural Capability: pasture and hay, vegetables, and blueberries.
- Limitations: drainage. If the surface layer becomes excessively dry, soil subsidence and cracking is induced. If well managed muck soils have potential for truck crop production.

(iv) Lumbum Typic Mesisol
- Parent Material: organic
- Drainage: very poor
- Agricultural Capability: cranberries, blueberries, and forage. If water table is controlled and surface fibric layer decomposed, carrots, lettuce, and other truck crops can be grown.
- Limitations: poor drainage. Artificial drainage is required for agricultural use. It should be below the rooting depth of a crop but high enough for subsurface irrigation.

(v) Nicholson Podzolic Grey Luvisol
- Parent Material: glaciomarine
- Drainage: moderately well to well
- Agricultural Capability: among the best Langley upland soils for agriculture. Good for hay and pasture, small fruits and vegetables.
- Limitations: located on undulating topography which makes the depressions (mainly occupied by the poorly drained Scat series) difficult to manage and cultivate; otherwise a good soil.

(vi) Ross Rego Gleysol
- Parent Material: alluvium
- Drainage: very poor
- Agricultural Capability: hay and pasture plus rough grazing in uncleared areas.
- Limitations: the very poor drainage and dense swamp forest cover. Reclamation would require modification of these two elements and the expense incurred might
be in vain due to frequent flooding and lateral seepage from streams. Access is difficult if Ross soils are located at the bottom of deep ravines.

(vii) Scat Orthic Humic Gleysol
- Parent Material: glaciomarine
- Drainage: poor
- Agricultural Capability: limited: mainly hay and pasture or for water storage.
- Limitations: poor drainage, poor structure, and shallow rooting depth. Scat soils are considered of fair to poor suitability for agricultural production.

(viii) Sunshine Orthic Humo-Ferric Podzol
- Parent Material: marine/glacial outwash
- Drainage: well
- Agricultural Capability: hay and pasture. Improved fertility would allow cultivation of small fruits and other crops.
- Limitations: droughtiness and low fertility (i.e. light textures, low moisture holding capacity, and low plant nutrient supplies).

(ix) Whatcom Luvilsolic Humo-Ferric Podzol
- Parent Material: glaciomarine
- Drainage: moderately well
- Agricultural Capability: forage and pasture, small fruits, vegetables, horticulture.
- Limitations: mainly economic, including the high cost of forest cover removal. In addition the exposing of the compact, impervious parent material upon clearing will necessitate years of intensive management with manure and fertilizer to achieve satisfactory productivity. Otherwise Whatcom is one of Langley's better upland soils.

d. Restraints on Urbanization - the Langley municipal council has placed this particular area with the two hectare zone for subdivision control. It is also within the agricultural land reserve. Although much of the site is fairly well drained it is interspersed with pockets of poorly drained soils. Sewage disposal is one urban factor which could be adversely affected by the organic soils in the area. Moreover the forested areas would be expensive to clear. Because much of the area is underlain by glaciomarine sediments and the water therein located at depth, tapping the reservoir is difficult. Since the flow is
frequently insufficient for irrigation purposes with respect to the present types of land use, it would be logical to assume that urbanization of the site would exacerbate the problem as far as domestic or industrial water supplies were concerned.

D. SITE INFORMATION -- DELTA, B.C.

1. Geography and Land Use

Delta Municipality, located at the western end of the Lower Fraser Valley, totals 17,893 hectares of land (Luttmerding and Sprout, 1968). Its boundaries are the south arm of the Fraser River on the north, 120th Street on the east, Boundary Bay and the Canada-United States border on the south, and on the west, the Strait of Georgia. The mainland portion of the municipality is supplemented by several islands, the most notable among them being Annacis, Reifel, Tilbury and Westham. Delta is engaged in a variety of land uses which reveal the extent to which it has become a "bedroom" community of Vancouver. Residential subdivisions are centred mainly in Ladner, North Delta, and South Delta (Tsawwassen). The retail sector, considered to be somewhat underdeveloped at present (Business Life, 1979), is located principally in Ladner and Tsawwassen. Access to Richmond is via Highway 499 and the
George Massey Tunnel. Highway 10 (Ladner Trunk Road) provides a link with Surrey and eastern Valley districts, and Highway 17 (Tsawwassen Highway) connects Delta with the Vancouver and Gulf Islands ferry terminal. B.C. Hydro Railway services the coal and petroleum export terminal at Roberts Bank.

Industrial enterprises are largely settled on two islands, Annacis and Tilbury. Annacis, about 480 hectares, has been partially developed by Grosvenor International, and to-date its Annacis Industrial Estate covers about 160 hectares and contains approximately 915,000 square metres of buildings (Business Life, 1979). Products range in nature from cake mixes to pollution control equipment, from wire products to auto import storage. The islands disadvantage is its lack of direct accessibility to Delta. This must be gained via Surrey and New Westminster. Tilbury Island Industrial Park, administered by the British Columbia Development Corporation, was created in 49 and 40 hectare stages respectively. Another 160 hectares, some of which is still in the agricultural land reserve, has been suggested for further industrialization. The island is readily accessible from Delta via River Road. Other commercial areas include Burns Bog (peat extraction and processing) and the River Road area (cement manufacturing). In addition there is a viable fishing industry and more than 800 fishermen are based in the municipality (Business Life, 1979).
Reifel and Westham islands lie at the opposing end of the land use spectrum, the former the site of a well known bird sanctuary and the latter a very successful agricultural community, one which enjoys one of Canada's outstanding soil - moisture - climate regimes. Both are in the agricultural land reserve and are somewhat isolated. A single, one lane bridge, spanning Canoe Pass, is the only access way to the mainland.

Delta's agricultural activities are widely varied and include dairy and beef cattle raising, poultry and egg production, and the growing of such crops as sweet and silage corn, canning peas, beans, potatoes, and small fruits.

2. **Geology**

Like Richmond, Delta is contained within the Fraser Lowland subdivision of the Coastal Trough. Soils are predominantly Fraser River alluvial deposits - fifteen or more metres deep - along with substantial peat accumulations in the Burns Bog region.

All Delta's lowland soils, with the exception of the Tsawwassen series, are classified as poorly drained (Luttmerding and Sprout, 1968). Infiltration and surface runoff are inadequate and, unless controlled, tend to retard crop germination and render cultivation difficult. Dykes have been installed to maintain proper water levels.
Upland soils have largely been urbanized and agriculture per se is limited to home gardening.

3. Community Development

Settlement in Delta began in 1857 with a land holding on Annacis Island being recorded in April of that year (Taylor, 1958). Further settlement followed in other areas, notably Annieville, Boundary Bay, and North Delta, with incorporation occurring in 1879.

Pioneers encountered three main problems: flooding, drainage, and insect nuisance. Dyking, initiated by W.A. Ladner, became a district priority, and it is a tribute to the workmanship of an earlier era that structures begun in 1895 remained virtually intact against floods for over sixty years. In 1882 the first effective drainage system was introduced on his East Delta farm by the late John Oliver, a former provincial premier. His method became standard throughout the municipality. As a corollary to improve dyking and drainage the insect nuisance abated as breeding grounds dried up.

Prior to 1900 land holdings were relatively large, many exceeding two hundred hectares (compared with two farms greater than 224 hectares remaining by 1951). In 1894, 4,216 hectares were under cultivation, mainly in grains and hay. A further 2,566 hectares were classified as pasture.
Reliance on grains and hay as the principal farm products diminished with the 1903 opening of a Great Northern Railway branch line between Colebrook (in Surrey) and Port Guichon on the Fraser River. Reliable transportation to urban markets stimulated the fledgling dairy industry into becoming the area's most valuable agricultural commodity. Further diversification followed. Poultry and eggs, potatoes and other vegetables, small fruits, and beef cattle entered the farming scene and have remained to the present time.

Fishing was an important industry before the turn of the century but less has been recorded about its early days as opposed to those of agriculture. It is known to have begun around 1890, with sockeye salmon as the main catch. Two principal fishing communities emerged: Port Guichon, mainly European; and Sunbury, largely occupied by Japanese. In addition canning facilities were built.

Early land transportation was difficult, especially in the lowland where soggy soil conditions persisted. By 1890 the present road pattern was established and 1913 saw rock and gravel surfaces replace corduroy ones.

Access to its eastern Valley neighbours has existed for many years but Delta waited until the 1950's before it was directly connected to Richmond by the George Massey Tunnel. The opening of the tunnel hastened a hitherto slow population growth which, in turn, contributed to an overall decline in
agricultural acreage. Population currently is about 74,000 (Business Life, 1979).

4. **Restraints on Development**

Delta is blessed with abundant space and a fine climate. However development and land use planning are made somewhat difficult by the fact that the municipality contains five distinct and separated physiographic regions: the residential communities of South Delta (Tsawwassen), Ladner, and North Delta; the agricultural lands; and the Annacis Island industrial estate (Greater Vancouver Regional District, 1976). For example, North Delta is more closely aligned with Surrey, with respect to shopping and employment, than to Ladner and Tsawwassen, and Annacis Island is not directly accessible from Delta at all. The agricultural lands surround and isolate the residential areas from one another. Thus the municipality is fragmented.

Three factors pose limitations to extensive urbanization. They are agricultural preservation, potential flooding, and the extensive peat accumulations.

More than half of the Class One and Two soils within the Greater Vancouver Regional District are situated in Delta. About 13,200 hectares form part of the agricultural land reserve and around 8,800 hectares of this total are in production (G.V.R.D., 1976). While at present most
urbanization is confined to the uplands, Annacis Island, and parts of River Road, rapid growth has placed pressure on farmland. In recent years extensive subdivision building has resulted in one of the Regional District's lowest densities. If this trend continues the municipality could run out of suitable residential land by 1986. Furthermore, the proposed reactivation of the Boundary Bay airport and an expansion of Roberts Bank has elicited concern from the farming community about potential agricultural soil losses if these projects proceed (Business Life, 1979). It remains to be seen how strong a limiting factor the agricultural land reserve will prove to be regarding farmland preservation.

Flooding affects several land uses and in varying degrees. It does, however, afford further protection from development to those portions of the agricultural land reserve which are located in the Fraser River estuary.

The third factor limiting growth is the extensive peat accumulations. These soils are not suitable for development due to an excessive water holding capacity, poor drainage, and proneness to compaction upon loading. The large amount of fill needed for construction purposes would add substantially to the cost of such construction.
5. **Site Information**

a. **Area** - approximately 2.9 square kilometres of territory on Westham Island, including all land within the boundaries of areas identified as 89 G2, 90 G2, 100A G2, 101A G2, and 190 G2 (92 G/3 E,W; edition 2 ASE; series A 721 - Vancouver South).

b. **Topography** - mainly gently undulating with slope values ranging from 0.5-2 percent.

c. **Soils** -
   (i) **Crescent Orthic Gleysol**
       - Parent Material: alluvium
       - Drainage: moderately poor to poor
       - Agricultural Capability: can be used for a wide variety of crops including grass - clover forage, potatoes, beans, canning peas, sweet corn and other vegetables, cereal grains, clover seed, sugar beet seed, and strawberries.
       - Limitations: mainly drainage. Artificial drainage is required for control of high winter water tables to protect perennial crops and to facilitate spring cultivation. These soils puddle if cultivated when wet.
(ii) Tsawwassen Orthic Regosol
- Parent Material: beach deposits
- Drainage: moderately well to well
- Agricultural Capability: very limited; mainly forages
- Limitations: droughtiness plus low cation exchange capacity.

(iii) Westham Saline Rego Humic Gleysol
- Parent Material: marine and non-marine deposits
- Drainage: poor to very poor
- Agricultural Capability: can support a wide range of crops including grass-clover forages, canning peas, sugar beet seed, strawberries, potatoes, beans, cereal grains and vegetables.
- Limitations: poor drainage. Artificial drainage is required to control winter water table and to facilitate spring cultivation. These soils puddle and compact if cultivated when wet.

d. Restraints on urbanization - a true farming community, Westham Island has successfully resisted urban development for the following reasons:
limited access to the mainland portion of the municipality; the high water table and threat of flooding; prosperity of the farmers over a long period of time; the presence of the Reifel Island bird sanctuary and the Alaksen National Wildlife Refuge; and the island forms part of the agricultural land reserve.
EVALUATION OF RESEARCH RESULTS

A. Richmond - North Site (See appendices)

Principal features noted over a 20-year period were:

(1) lack of subdividing on most of the site. A few buildings were added or deleted along the periphery and small roads constructed in both the northern and southern halves of the site. An equestrian track was added to the large holding in the southeastern quadrant. Soils affected were the Blundell-Delta and Delta-Blundell complexes;

(2) small portion of the southwest corner of the site being converted to urban use on the poorly drained Blundell-Annis complex. Conversion of previously idle land first observed on 1963 photographs;

(3) approximately 0.3 km², located on Blundell-Annis, Blundell-Delta and Delta-Blundell complexes being converted to recreational use. A sequence of photographs, beginning in 1969, revealed the emerging lenticular pattern of a golf course.

(4) the addition of three new dwellings in a small-lot subdivision along the western end of Westminster Highway.
Agricultural land use on this site - mainly dairying - remained relatively intact but with some modifications; a four hectare commercial development at Westminster Highway and Number 6 Road, some subdividing of small properties on Westminster Highway, and a golf course development.

With the exception of the four hectare parcel (classified as "service district") the entire section is zoned for agriculture and further subdividing is prohibited (Richmond Planning Dept., 1979). The golf course represents an allowable deviation due to its recreational nature.

With respect to soil quality the section can be roughly bisected, with the northern half possessing the better soils. It is in this area where the least amount of change was observed. A few building additions and deletions, a small road to the interior of the northwest quarter-section, plus the removal of a narrow strip from the aforementioned quadrant for the golf course comprised the changes. On the southeast quartersection, where soil quality is somewhat lower, additions and deletions of buildings took place but its agricultural character remained intact. Appropriately, the poorest soils, located in the southwest quartersection, were the recipients of urban and recreational development.

In this case the higher quality soils, aided by beneficial zoning, were not affected by urbanization.
B. Richmond – South Site (See appendices)

Principal features noted over an 18-year period were:

1. addition of Shell Road, displacing some soil of Triggs-Lumbum and Lumbum-Triggs complexes. The road paralleled existing railway line and bisected the site from north to south;

2. clearance of approximately 0.3 km$^2$ on Triggs-Lumbum complex and Richmond series, most of it affected between 1954 and 1969;

3. additional building construction, especially along Blundell Road, Granville Avenue, and Number 5 Road. The Triggs-Lumbum and Lumbum-Triggs complexes were the most affected along with minor portions of the Richmond series and the Blundell-Annis complex. Forty-one new buildings were observed.

Organic soils occupy almost one hundred percent of the south site and, in their native state, preclude most soil-based agricultural activity. Blueberry and cranberry cultivation is the exception. Until 1971 at least, a considerable portion of this site was employed in agricultural activity, principally blueberry production. Blueberries have traditionally found ready markets in the Greater Vancouver area and elsewhere.
This reason, and profitability, would account for these small producers remaining in business.

High water-retention capacity and the tendency to compact excessively when loaded also render these soils as unsuitable for engineering purposes. Notwithstanding these inherent deficiencies residential infringement along the margins of the site advanced steadily between 1954 and 1969. The low density, peripheral land use pattern observed here is consistent with one aspect of urban sprawl outlined in Part I.

This site presented a paradox. Farming and engineering soil conditions are adverse, yet agriculture and residential development of sprawl-like density coexisted. The situation may be more attributable to economic and zoning factors than to soil characteristics.

The economic elements of blueberry farming in Richmond are varied (Hitchman, 1974). First, a six hectare minimum parcel size has been suggested for viability of an enterprise. Even so, the income derived from this small a unit may be insufficient to cover fixed costs of operation. Second, bushes require from eight to ten years after planting to produce optimum yields, thus postponing maximum cash returns. Third - and perhaps the most crucial element - selling prices for produce are determined elsewhere, namely in the United States. The combination of growing conditions in the midwest (Michigan) and market conditions in California sets local
prices. Accordingly, growers may encounter a situation where bumper crops fetch high prices and sparse crops, low returns, a condition which contradicts the conventional views regarding supply and demand. Lack of ability to control the selling prices for their products leaves growers vulnerable to economic pressures and vagaries of the marketplace if costs exceed income. One method of recovering costs is the sale of property for subdividing purposes, a prospect not totally unpleasant in view of rising real estate prices in a rapidly growing municipality (Hitchman, 1974). Sales, however, are subject to zoning regulations.

By-laws passed during the 1950's encouraged small scale agriculture in the vicinity of the Brighouse commercial centre by permitting small holdings of a minimum of 0.2 hectares (including parcels on the study site) to exist near that area (Foerstel, 1964). Subsequent revisions (1963) placed the site within the "agricultural district" zone. Small holdings were still permitted.¹ Larger parcels could be subdivided into 0.2 hectare lots, providing the minimum allowable frontage faced onto an improved road, for example Granville Avenue (Richmond Planning Department, 1979). Conformance with these regulations led to the parcels' excess land (or "back end") becoming the landlocked interior of the site and which became, in turn, consigned to dormancy with respect to development.

¹ On this particular site most lots are 0.32 hectares and the by-law permits subdividing to 0.16 hectare parcels.
It would be logical to assume that the land use patterns developed on this site were at least partial outgrowth of this type of subdividing.

C. Langley (See appendices)

Principal features noted over a 21-year period were:

1. considerable land clearing, for agricultural purposes, outside the immediate Anderson Creek area. Approximately one square kilometre was cleared and soils affected were mainly Whatcom-Albion, Whatcom-Scat, and Whatcom-Scat-Nicholson complexes;

2. progressive forest thickening along, and in the vicinity of Anderson Creek involving Nicholson-Ross, Whatcom-Scat-Nicholson, and Whatcom-Scat complexes;

3. some peripheral construction of farm and residential buildings;

4. several small, irregular shaped clearings, suggestive of large parcel subdivision, in the northeast corner of the site and on Whatcom-Albion and Whatcom-Scat complexes;

5. small lot development, affecting Whatcom-Scat-Nicholson and Whatcom-Sunshine complexes near 18th Avenue right-of-way.
The uplands of Langley Municipality are the end products of Pleistocene glaciation and most of the soils therein reflect this origin. Upland organic soils occupy depressions, seepages, and areas along streams, for example Anderson Creek. Undoubtedly soil and topographic features influenced the type of land use found on this site.

Forest cover remained in some areas and thickened or regrew in others. Cost of removal, soil infertility and/or permeability for agriculture, and poor drainage and steep topography associated with Anderson Creek may partly account for this phenomenon.

Subdividing appeared to occur, principally in the northeast corner. This was permissible as the municipality was governed by a subdivision control by-law - rather than zoning per se - which allowed two hectare parcels in the area bounded by 24th Avenue, 216th Street, 28th Avenue, and 224th Street. Only one residence per parcel was permitted. South of 24th Avenue four hectares represented the minimum allowable lot size, the housing stipulation remaining unchanged (Langley Planning Department, 1979). No provision was made for commercial development and none was observed on the photographs.

Most land clearing was agriculture oriented and the better soils were employed for this purpose. However, unequal drainage abilities possessed by the soils comprising the affected complexes appeared to restrict the cleared areas to
hay and pasture utilization, thereby promoting non-soil based activities such as poultry raising.

When compared with the other sites studied the Langley site is more isolated from the large, densely populated urban areas. Responsibility for deterring urban growth in this area lies more with isolation, subdivision control, and topographical factors than it does with soil quality.

D. Delta (See appendices)

Principal features noted over a 20-year period were:

(1) the virtual absence of land use changes over the 20-year study period;

(2) completion of nine new residential and/or farm buildings and the deletion of six others, most of which occurred between 1954 and 1963;

(3) completion of a commercial building and adjacent parking lot between 1963 and 1969. Location is on Westham Island Road between Kirkland and Savage roads. Soil complex affected was Crescent-Westham.

Little change was observed in this traditionally agricultural area and the amount of good quality soil displaced
for the commercial building and parking lot was considered to be insignificant. Although zoned for agriculture only, a development designed for public use is permitted without infringement on zoning regulations (Delta Town Planning Department, 1979). Telephone or hydro installations are in this category.

The high quality soils of Westham Island have successfully resisted urban encroachment mainly, the writer believes, on their own merit and because of the economic prosperity of the farmers. Other factors, such as isolation, zoning, and an agreeable climate have obviously been beneficial. However, one would hardly expect the continuity of farming operations on the island if soil properties had rendered the enterprises uneconomical.
CONCLUSIONS

The results of this study appear to indicate that soils suitable for agriculture, regardless of their quality, will not by themselves forestall urban growth. Other protective elements are required.

With respect to Westham Island the isolation afforded by Canoe Pass and the single lane bridge was a positive factor in delaying urban growth from nearby Ladner. Relatively large parcel sizes were another. Moreover farmers have, for several decades, had profitable operations, and as long as they continue to do so the soils of Westham Island will likely be farmed.

In the case of the Langley site the subdivision control by-law, a probable outgrowth of the citizens' wish to retain a rural lifestyle, has certainly been valuable to agricultural activity in the area. It is not inconceivable that, in the absence of the by-law, "spillover" from rapidly growing Langley City and the nearby Brookswood Subdivision would have occurred. Indeed some speculation may already have taken place by some people hopeful of future by-law changes. While the by-law does afford protection for a rural way of life, its designated minimum lot sizes tend to promote sprawl patterns and densities, leading to land use inefficiency.

Agricultural soils in Richmond are in the unenviable position of being very close to the City of Vancouver.
municipality itself has experienced unabated growth since the late 1950's, expansion which has exacerbated the loss of excellent agricultural soils to urban development, especially on the municipality's western side. It is to the credit of Richmond's public administration that the long-term detrimental effects of urban sprawl were recognized several years ago and that steps were taken to ensure more orderly residential and commercial growth. By and large the zoning by-laws formulated have been quite effective in the prevention of subdivision and development of farmland (Foerstel, 1964).

On the north site, most parcels have remained large, thus increasing the likelihood of being profitably operated. The golf course represents an excellent use of the area's lower quality soils by retaining the land as a green open space, space which could revert to agricultural use if necessary. Moreover, the institution of improved drainage, aeration, and fertility - all requirements of good course maintenance - have served to improve soil quality. As far as the small lot residential section is concerned, zoning regulations appear to have checked its growth.

The south site is another matter. Sprawl-like densities and peripheral development are longstanding features, abetted by the 0.2 hectare minimum parcel size allowable. Although the soils on this site are normally considered to be poor for most soil based agriculture, they are excellent
for blueberry production. Given the strong demand for the fruit and proximity to the principal marketing areas, one might expect this site to be relatively safe for future blueberry-growing. The writer does not believe this to be the case. Parcel sizes are relatively small, perhaps too small in many instances to be operated economically. In addition, farmers are confronted with nuisances such as starlings, dogs, weed and labour problems, and unsympathetic urban neighbours. The crucial factor, however, appears to be the cost of land in the area, reported to be around $74,000 per hectare in 1974 (Hitchman, 1974). Prices have substantially increased since then. ¹ If one were to consider the cost of such inputs as mortgage amortization, taxes, fertilizer, machinery, labour, and new plantings and add to them the unreliability of market price levels, it is not difficult to foresee future problems for the area if a sufficient number of growers are unable to defray operating expenses. Despite the municipality's good intentions, the 0.2 hectare minimum lot size has served to encourage land use inefficiency, as witnessed by the dormancy of interior land.

Fringe agriculture is in trouble in this country and has been so for some time (Crerar, 1970). Canada and the province of British Columbia have not been blessed with an overabundance of fertile soil. Unless good land use planning assumes a greater importance than it does at present, *

¹ A 1979 Block Bros. real estate catalogue lists an asking price of $176,900 for a 1.53 hectare property at Granville Avenue and Number 5 Road. This is the equivalent of $115,621 per hectare.
significant amounts of remaining good soils could be permanently removed from productive use. Some suggestions which may be of value are:

1) remove incentives to speculate in agricultural land. Strongly enforced zoning regulations, restrictions on the length of time land may be held for subdividing, and assessment for agricultural purposes, rather than for "highest and best use", would help to solve this problem;

2) consolidate small parcels into larger ones in order to promote economic viability and to discourage under-utilization. Richmond's blueberry areas might benefit from this action;

3) consider non-soil based agricultural activity where soil quality is too low to permit crop production or where parcel size is limited. Mink ranching, poultry raising, horticulture, bee-keeping, and horse breeding are some examples. Many of these occupations have been undertaken in Langley but are also appropriate for small and/or infertile areas elsewhere in the Lower Fraser Valley;

4) implement policies to save fringe or other agricultural soils from unsuitable urban uses. The passage of the British Columbia Land Commission Act (1973), by the provincial government of the day, has slowed the loss of agricultural soils in this province. Emulation by administrations elsewhere would benefit Canada as a whole.
The availability of good soil and of useful farmland cannot be taken for granted, either in this province or anywhere else in Canada. As much at stake as portions of our food supply is the right to the quality of life we have come to expect and, hopefully, appreciate. Urban sprawl is a long-term detriment to any community and one that should not be tolerated on useful farmland near our cities.

Little writing has been done regarding agricultural soil losses in the Lower Fraser Valley of British Columbia. The writer believes that more research into this topic is required and that a more efficient methodology be developed. If this thesis can benefit subsequent researchers or aid the community at large, its undertaking will have been worthwhile indeed.
LITERATURE CITED


BUSINESS LIFE IN WESTERN CANADA. 1979b. Richmond sets the pace for solid growth. 7(2): 74-80.

CENTRAL FRASER VALLEY REGIONAL DISTRICT. PLANNING DEPARTMENT. 1972. Regional farmland study.


DELTA TOWN PLANNING DEPARTMENT. 1979. Personal communication.


FRANSON, R.T. 1972. The legal and institutional structure for planning in the Fraser Valley. Proceedings from a seminar "Land Use in the Fraser Valley - Whose Concern?". Centre for Continuing Education and Fac. of Science, Univ. of British Columbia with assistance from Douglas College.


LANGLEY MUNICIPAL PLANNING OFFICE. 1979. Personal communication.


PEARSON, N. 1972. Fraser Valley - rape it or preserve it? Proceedings from a seminar "Land Use in the Fraser Valley - Whose Concern?". Centre for Continuing Education and Fac. of Science, Univ. of B.C. with assistance from Douglas College.


RICHMOND TOWN PLANNING DEPARTMENT. 1979. Personal communication.


ST. JOHN'S CALGARY REPORT. 1979. Tax assessment: a farmer is a farmer is a... 2(41): 9-11.


SELECTED REFERENCES


DE VRIES, J. 1972. The role of agricultural use of land in an urban society. Proceedings from a seminar "Land Use in the Fraser Valley - Whose Concern?". Centre for Continuing Education and Fac. of Science, Univ. of British Columbia with assistance from Douglas College.


KAISER, E.J. and R.W. MASSIE. 1968. Landowner behaviour: factors in the decision to hold or sell property on the urban fringe. Inst. of Social Research, Univ. of North Carolina, Chapel Hill. Research Previews 15(1).


___________. 1956. Urban sprawl.


___________. 1961b. Industrial land prospects in the Lower Mainland Region of British Columbia.

___________. 1962a. Land for farming.


APPENDIX A.  KEY.
KEY

BUILDINGS - 1963
- 1969
- 1971
- 1973
- 1974 (LANGLEY)

BUILDINGS

BUILDINGS DELETED

WOODED/SCRUB

CLEARED

RAILROAD

IMPROVED - URBAN

IMPROVED - AGRICULTURE

IMPROVED - RECREATIONAL

CLEARED - IDLE

FOREST REGROWTH
APPENDIX B.  RICHMOND -- NORTH SITE.
RICHMOND - NORTH SITE (1954)

CAMBIE ROAD

SCALE: APPROX. 1:12,000
APPENDIX C. RICHMOND -- SOUTH SITE.
RICHMOND - SOUTH SITE (1954)

GRANVILLE AVENUE

SCALE: APPROX. 1:12,000
APPENDIX D.  LANCASTER SITE.
APPENDIX E. DELTA SITE.
APPENDIX F. LIST OF SOILS.
## APPENDIX F. LIST OF SOILS

<table>
<thead>
<tr>
<th>Soil Name</th>
<th>Symbol</th>
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<th>Classification</th>
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<td>Humic Luvic Gleysol</td>
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<td>&quot;</td>
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APPENDIX G. LIST OF AIR PHOTOGRAPHS.
## Appendix G. LIST OF AIR PHOTOGRAPHS

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### Note:
- Coverage for Richmond South in 1973 and 1974 unavailable.